MACHINERY

OCTOBER, 1914

A TEN-MILLION-DOLLAR EFFICIENCY PLAN

HOW HIGH WAGES AND MECHANICAL EFFICIENCY HAVE LOWERED THE COST OF PRODUCT

BY HAROLD WHITING SLAUSON*

WHEN Henry Ford first made his sensational announcement of the plan to distribute $10,000,000 among his workers as a wage bonus, the industrial world gasped; when it recovered its breath, surmises as to the automobile manufacturer's object, and speculations as to whether he had become a publicist, a philanthropist, or merely mad, were almost as plenteous as the hordes of men who applied for work at the gates of his plant the morning after the plan had been made public.

Those who considered that, by this one announcement, Henry Ford had constituted himself the greatest advertiser in the world, were, in a measure, correct; the space devoted to the outlines of the plan on the front pages of the leading daily papers, and the editorial comment that supplemented the announcement could not have been bought for twice the sum involved. So, too, those who ascribed the origin or development of the plan to philanthropic motives were not entirely wrong, for it is known that Henry Ford takes great pleasure in the manner in which his workmen have profited by their increased earnings and improved their conditions of living. In fact, a staff of some 200 examiners is kept busy investigating the merits of each case, and any workman who, it is thought, would not apply his increased earnings to the benefit of his family cannot share in the distribution. This would seem to indicate that there is more than the material side connected with the Ford plan, and that one of its primary ideas is to work the greatest good to the greatest number of Ford employes.

Fig. 1. Small but Representative Group of Ford Employes lined up at Paymaster's Window

But the statements of those who would call Henry Ford mad, a fanatic, or a disturber of industrial conditions have been so thoroughly disproved that the reaction has now set in, and he is hailed as one of the keenest business men of the age—a man who can spend $10,000,000 in increased wages in one year, and realize a profitable return within the first month after the inauguration of the plan. The plan itself seems so gigantic that the average manufacturer is likely to lose sight of the fact that it is merely a somewhat elaborated type of profit-sharing, commensurate with the business done by the Ford Motor Co. The $10,000,000 represents approximately, 10 per cent of the gross

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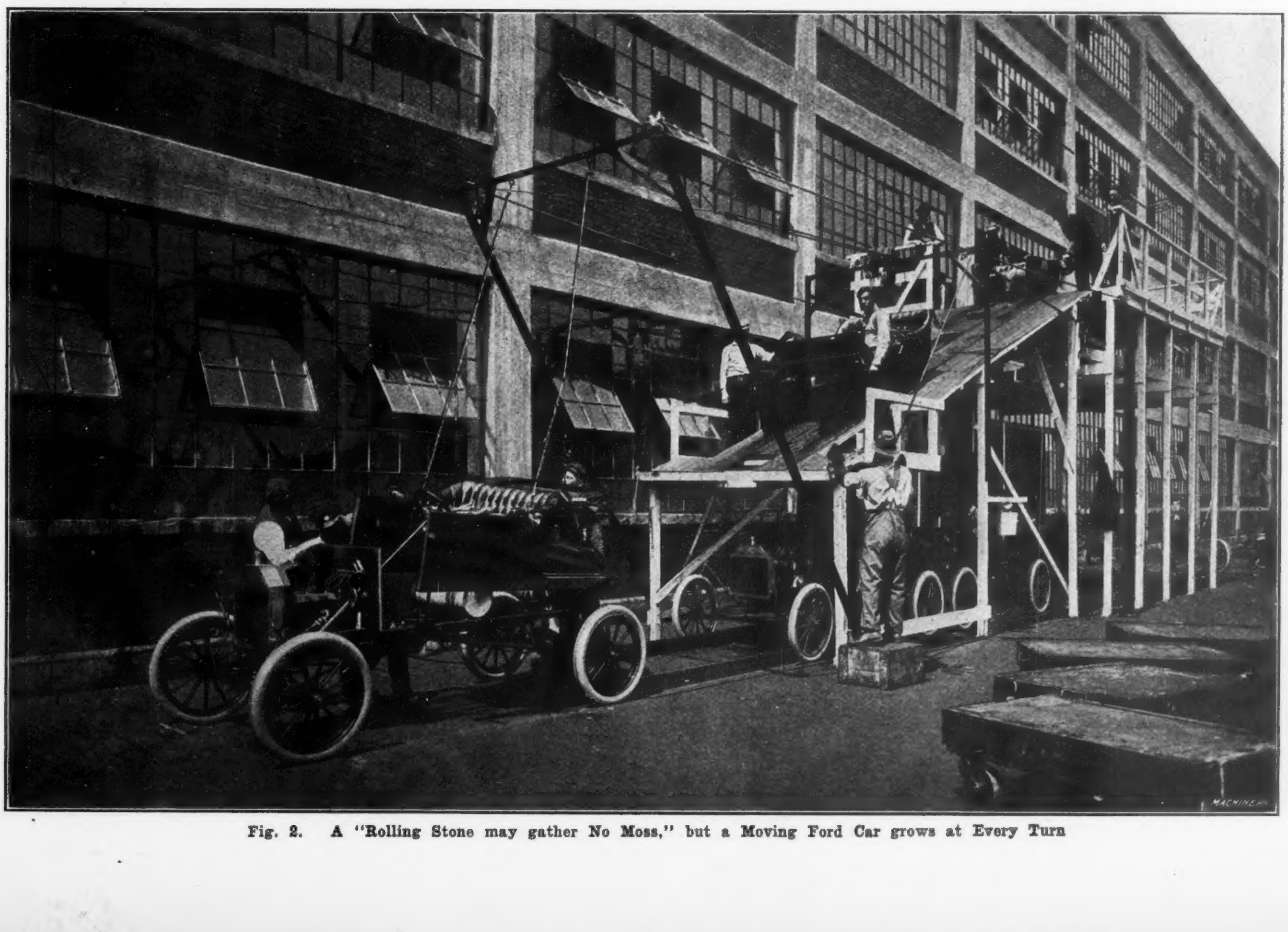

Fig. 2. A "Rolling Stone may gather No Moss," but a Moving Ford Car grows at Every Turn

value of the Ford output for 1914, and is distributed among the majority of some 16,000 men employed in the main Detroit factory and the various assembling stations in the larger cities. This money, however, instead of being paid at the end of the year, as a bonus, or in the form of a profit-sharing system, is included in the *daily* wage of every worthy man over twenty-one years of age, and of every woman or boy who contributes to the support of a family. The minimum wage paid to such persons is $5 per day, and this applies to the washers and men who sweep the floor, as well as to the more skilled classes of mechanics. A few of the best machinists and toolmakers receive $7 per day, and the whole scheme has served to give each participant a wage advance of from 25 per cent to 100 per cent over the former amount received by him.

Thirty dollars per week as a minimum wage for the least skilled type of labor would seem to mark, not efficiency, but rather administrative extravagance. To increase the ratio of wages to gross value of product from 15 per cent to 25 per cent appears to be retrogression instead of advance—until figures are examined and the unique conditions prevailing in the Ford plant are thoroughly understood. As a single instance of the success of the plan from a monetary standpoint, it is but necessary to point out that in February, after one-twelfth of the $10,000,000 had been distributed in the form of the wage bonus, production had been increased 40 per cent over that of the preceding month, and this result was secured with a force of 200 men less. If increased production could be maintained at this rate, the 10 per cent additional cost represented by the wage increase would assuredly be money well invested. And the nature of the plan, and its application in the Ford plant is such that this continued increased production with the same force is not only a possibility—but almost a certainty.

In order the better to understand how such results are possible, and to observe in just what manner the plan was evolved to exactly fit the requirements found in the Ford factory, it is necessary to study the general plan of manufacture of this world-famous product. It might logically be supposed that a force of 15,000 men employed under one roof would be sufficient to make cars by hand, and to almost entirely eliminate the use of machinery. But when we think of the production of over 200,000 Ford cars in 300 working days, and realize that this means that each workman completes somewhat over thirteen cars during the year, it is evident that only by the aid of the most modern machine tools and efficiency of the highest type can such a feat be accomplished. The contrast is all the more remarkable when applied to the average high-priced car selling at $4000. In one of the best-known factories building cars of this type, 4000 men are employed to turn out 3000 cars—or only three-quarters of a car per year per man—and yet this plant is famous for the quantity and quality of the machine tools used in the production of its cars.

In the Ford plant, the human element has been eliminated as far as possible—and yet it was solely through its appeal to human nature that the wage bonus plan proved so successful in increasing production. However, this is but one of the many paradoxes and anomalies that are to be found in an investigation of this most wonderful of motor-car factories. The Ford plan does not provide for an extra bonus in the form of a money prize to be given to the men who excel in quantity or quality of work; the daily distribution of the "minimum wage" would have been made the same in February, even though the figures had shown a decrease in production. Henry Ford has announced that this wage will prevail throughout 1914, and that he has every reason for believing that events will warrant its continuation indefinitely; but production figures, as a goal to be obtained, are not held as a bait above the workman's head. This is probably due to the peculiar fact that the average workman has but comparatively little control over the quantity of his output; the Ford factory is one vast machine, and it is an actual fact that the speed at which a dozen or so of the conveyors are driven determines the rate of production in the factory. The Ford employes are the "breaker boys" of

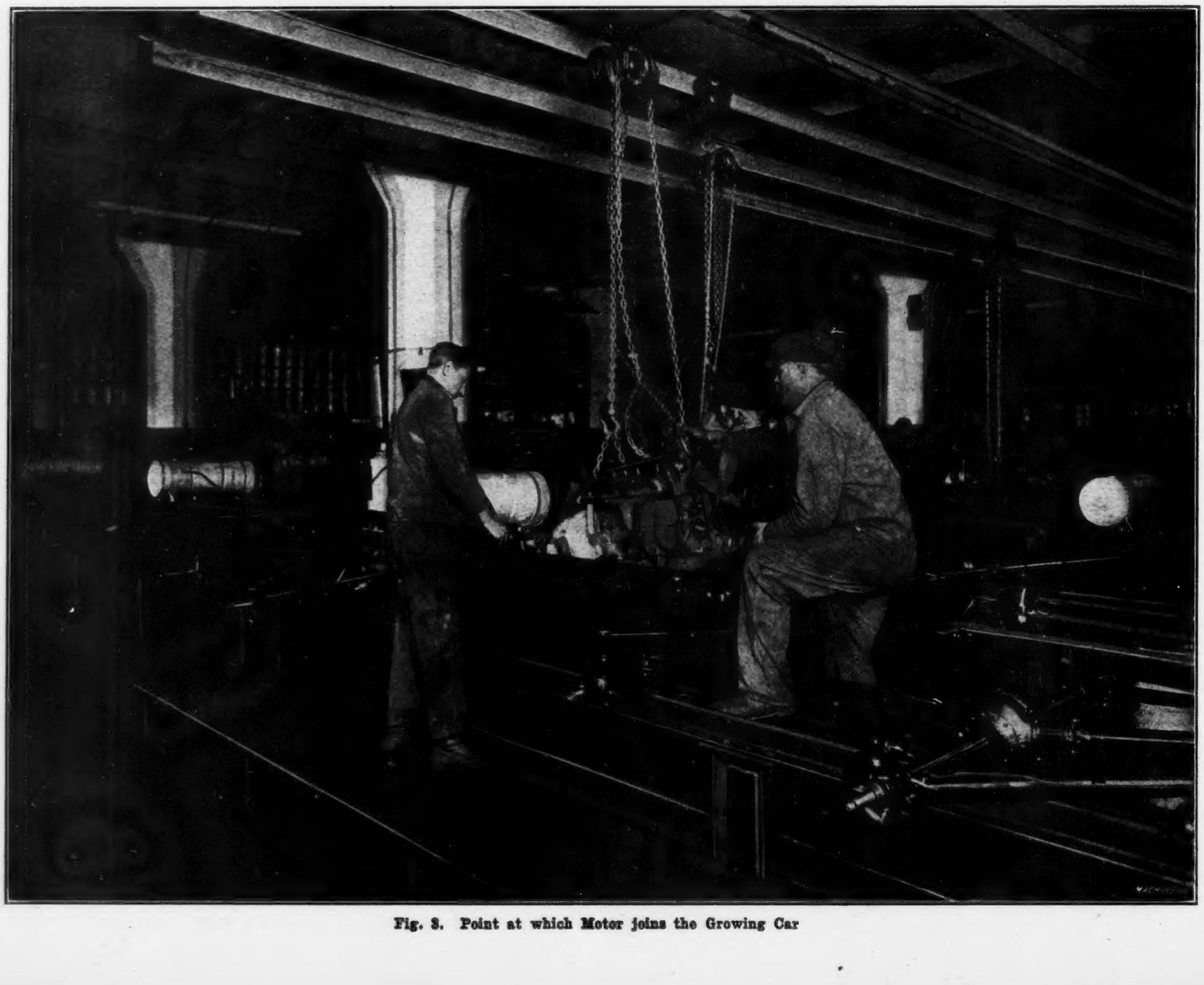

Fig. 3. Point at which Motor joins the Growing Car

Fig. 4. There are no Finished-parts Stock-rooms in the Ford Factory—These are replaced by Overhead Bridges

the Ford automobile "mine"; the partially assembled cars or their parts move before them on an endless chain, and there is but so much time permitted for each operation. This is a feature of Ford manufacturing methods that is of comparatively recent origin, and one that was adopted primarily to meet the requirements of the new plan.

Probably the majority of those who have kept pace with improvements in manufacturing methods are familiar with the system in vogue in the Ford foundry, in which the molds are machine-made and, in the flasks, are placed on a series of moving tables. The tables are placed but two or three feet apart, and move around an oval-shaped overhead rail. As the empty tables are carried by the molding machines, the flasks are placed thereon, and a few "feet" later, the ladle men are ready to pour the molten metal into the molds. If there is a delay at the ladles, the men merely must pour faster to "catch up" with the flasks as they pass by in endless procession. By the time the flasks have been carried to the opposite side of the oval, the castings have cooled sufficiently to be removed, and the newly pressed molds are set in place. Approximately two engine castings per minute are made in this manner.

This same system is applied to practically all of the machine work and assembling operations, but it is in the latter department that the greatest strides have been made. Consider, for example, the assembly of the motor. The machined and reamed casting is placed on a pair of rails at about work-bench height, and as it is moved at a constant speed, the various parts are added. Two men—standing opposite each other—will insert the pistons; another pair install the crankshaft; another the camshaft; and the next, the bearings; until finally the crank-case, cylinder-heads, valves, and gears are all set in place by as many additional "crews," and their followers tighten the bolts that have previously been inserted. By the time each motor is completed, it has reached the end of the rails and is slid onto a movable framework on which it is taken to the "limbering" department for the purpose of lapping in the pistons and rings. But as an expression of the spirit of despatch and efficiency of the system, it is interesting to note that even on this short journey it is not immune from growth, for it is accompanied by a man with a paint pot who performs his work on those parts requiring attention before the next operation is begun.

Apply this system to every important part of the car—and finally to the car itself—and we may be able to form some idea of the machine-like regularity of production in the Ford plant. The rear axle assemblies grow, as they proceed on an endless chain in front of the two lines of workmen, each individual of which is ready with some part or tool to insert or tighten as the work moves by. The two halves of the tubular rear axle are placed together by one pair of men; the next pair insert eight cap-screws in as many holes in the flange of the differential housing that serves to clamp these two halves of the "dead axle" together; and the third pair tightens these, one man holding a socket wrench against the bolt head, while his companion opposite him sends the nut home by means of an electrically driven wrench made only to fit that size and type of nut. As the rear axle assembly is completed, the entire unit is disgorged, end up, into a vat containing the paint or enamel with which it is to be covered. While in this position it is fitted into a fixture by means of which all but the exposed ends may be submerged by the movement of a lever. This operation is supplemented by a man with a long-handled brush, who touches the portions not previously covered, and the unit is then automatically transferred to an elevating chain that carries it to the roof of the building and then to the place in the factory where it is to meet the growing chassis of which it is to become a part. But this portion of the building is some three hundred feet distant from the paint vat from which the axle has recently emerged, and, therefore, in order that no time will be wasted or motions lost, a drying room, having a temperature constantly maintained at about 110 degrees, has been constructed at the roof of the building throughout the length of the horizontal travel of the axle carriers. The result is that the axles reach their destination a few moments later, completely dry and ready for installation in the car. As these chains carry the axles at a speed equal to a slow walk, and as not over two feet separate each unit, it is possible that the reader will be able to grasp an idea of the immense quantity production that prevails in this plant. Of course, the speed of assembly cannot be as great as this, for the limited number of men working side by side could maintain no such pace, and there are therefore three

of these assembling tracks that unite at the paint vat, the product of which is carried on the single overhead chain.

With the frame as a starting point, the various parts of the chassis are added in the same manner—first the springs, next the axles, and then the wheels, followed in order by the gasoline tank, the driver's seat, the motor, and finally the radiator. As the rapidly growing chassis reaches the proper point, it is met by these various parts that are fed down from overhead chutes. There are no finished-parts stockrooms in the Ford plant, but, instead, the completed pieces are taken directly to these overhead bridges, from which they are fed into the chutes like so much gum in a slot machine. When the "sluice" is opened a set of four wheels, a radiator, a gasoline tank, a seat, or a pair of fenders is poured out onto the chassis that, unlike the proverbial rolling stone, has been gathering verdure at each turn. There are four of these chassis assembling tracks, and each delivers its completed car onto a set of revolving drums that serve to set the rear wheels spinning, ready to start the motor as soon as the tester is able to jump into the two-minute-old seat and throw in the clutch. While he is doing this, the radiator has been filled and a rubber hose connected with the exhaust pipe—and another Ford car has been born.

Under these conditions of machine-paced production, is it any wonder that the movements of the men become practically automatic and that output is regulated entirely by the speed at which the traveling chains are operated? Speed up the electric motors a notch and—presto! Ford production has increased another hundred cars per day without the necessity of hiring a single additional workman. No one, no dozen, no hundred of the wage earners is absolutely necessary to the organization; the work that the average man in the Ford shops performs could be learned in a few hours of instruction by an immigrant unable to speak a word of English—and yet the average wage received is $30 per week! But much as the monotony of each man's work might be expected to lead to discontent, the prospect of wages double those that could be obtained at any other factory for the same work serves as a deterrent and positions in the Ford factory are eagerly sought for. This has resulted in the elimination of what had previously been one of the serious problems of the organization—the instability of the personnel of the workmen. Before these high wages went into effect, each workman averaged less than ten months during which he remained in the employ of the company; and this necessitated the hiring of some 15,000 men each year in order to maintain the required force of 14,000 men. Now, however, with positions in the Ford factory at a premium, each man values his position, and the work of the employment office has been marvelously reduced.

As a further inducement toward permanency of employment, the new Ford plan provides for the arrangement of production so that the annual "slack season"—when inventory is to be taken, the machinery overhauled, and preparations made for the manufacture of the new models—shall occur during the summer when the great farms of the Middle West are in need of men for the harvest. This system practically provides for permanent employment of the men, the more so as the Ford Motor Co. maintains a sort of clearing house and undertakes to obtain positions in the harvest fields for its men. Another feature of the Ford plan, which must not be overlooked, is the conscientious endeavor to select only the best and most deserving workmen. As has been mentioned in a preceding paragraph, the home life of each employe is closely investigated, and the bonus is only given to those who would spend their wages wisely. The wife of a Ford workman receiving the minimum wage of $5 per day is not allowed to keep boarders, nor may she "take in" washing. Thrift is encouraged, however, and as evidence of the manner in which the men have retained or acquired this trait, it is but necessary to mention that the savings bank established near the factory had received, during the first five months of the operation of the plan, deposits amounting to somewhat over $3,000,000.

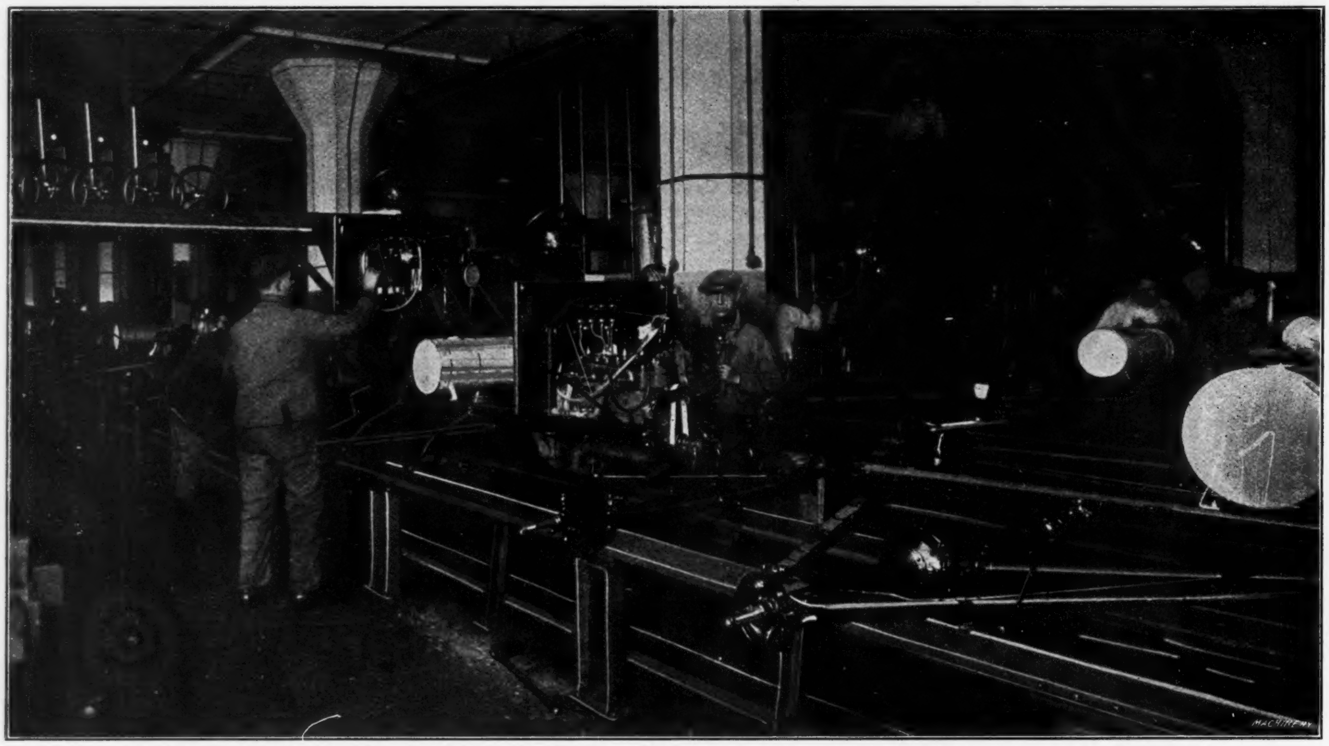

Fig. 5. Close View of Tracks on which the Ever-growing Chassis is mounted, and on which it travels at a Constant Speed

Naturally, there will be no strikes in a factory so liberal in the manner in which it treats its workmen; and if there should be, so large a number of men would stand ready to take the places deserted by the old employes that a strike would prove to be the most futile method in the world for adjusting whatever grievance might arise. The Ford automobile is a manufactured article that fills a world-wide demand, and the only problem to be met is that of producing this car as cheaply as possible. The answer to this problem lies, chiefly, in the wholesale use of machines and machine tools—"handmade" is a word unknown in the Ford factory; but the human element enters into the consideration, and this is, in reality, the one *variable* that must be dealt with. But to hold this variable within as restricted limits as possible, and, in fact, to reduce it to a *constant*, the Ford plan, dealing with the men and their compensation, was evolved. The question as to whether this plan has been proved to be successful or not can be best answered by a brief resumé of the results accomplished. Production has been increased without increasing the number of employes; the work of

each individual has been so standardized, specialized, and simplified that no skill is required in the manufacture of any part; the permanency of employment has been increased; the character of the workmen has been improved; the possibility of strikes has been practically eliminated; and positions in the Ford factory have been made so desirable that the places of one or all workmen could be filled immediately from men from the other factories in Detroit.

If all of this can be accomplished with an expenditure of only 10 per cent of the previous gross income, the plan is assuredly a success, for additions to the plant and equipment, together with the extra men necessary to produce these results, would have represented an outlay greatly in excess of this sum, and one that would ordinarily be obtained through a new bond or stock issue. Successful as this plan has proved itself to be when applied to the Ford plant, it is doubtful if it would meet with equal success in the case of other manufacturing enterprises. The Ford capital, plant, equipment, organization, and work were ideally arranged for the operation of such a plan, and the time was ripe for its inception. But certain of the principles involved can assuredly be applied to other businesses, and for testing such an idea on so large a scale, the industrial world owes a debt of gratitude to Henry Ford.

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A catalogue recently published by the Hindley Gear Co., of Philadelphia, contains a historical note of interest on Hindley worm-gearing. These gears take their name from an English engineer, who, about 1857, first pointed out that if a machine could be built to cut them, such gears would be superior to all worm-gears. Nothing was attempted in the way of producing these gears commercially, however, until Stephen A. Morse of Morse, Williams & Co. of Philadelphia, took up the matter in 1878. After building an experimental machine, the gears were finally produced commercially in 1880, and from that time have been used in Morse screw elevators exclusively. The characteristics of Hindley worm-gears are a concave worm, the teeth of which are in full contact with several worm-wheel teeth at once. A comparatively recent development is Hindley spiral gears, a term applied to that class of worm-gearing in which the angle of the teeth with the gears is such that either gear will drive freely in either direction and from either gear. These are made commercially in ratios from 1 to 1 up to 10 to 1 and are used chiefly for automobile rear axle drives.

A MULTIPLE WIRE-DRAWING MACHINE*

BY S. A. J.

At present, a good deal of interest is being paid to the methods of producing fine wire used for weaving purposes, etc. The continuous wire-drawing machine built by Messrs. Werths & Co., of London, England, together with a new method and apparatus for annealing and continuous pickling, washing, drying and winding of fine wire from phosphor-bronze, gun-metal, brass, copper and other fine metals, apparently presents marked advantages over processes hitherto used. This multiple wire-drawing machine differs in several respects from machines hitherto manufactured for the same purpose, as the drawing pulleys run on vertical shafts and are grouped around the draw-stones which are combined in a single adjustable die-holder, with the exception of one die-holder, which is fitted at the place where the wire enters the machine. This gives the machine a very compact and simple construction, as illustrated in Fig. 1. This compactness is of importance not only because of space considerations, but also from the point of view of supervision of the work, and, above all, on account of power requirements.

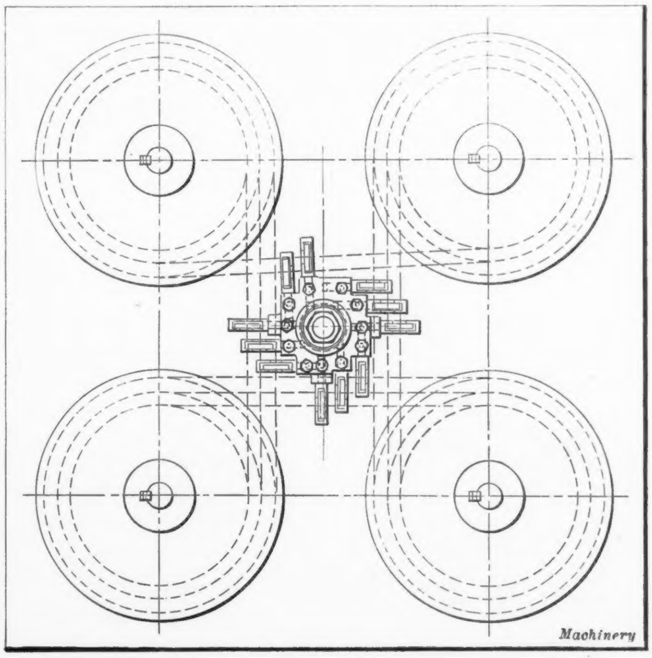

Fig. 1. Plan View of the Werths Multiple Wire-drawing Machine

It is a point of special importance that the whole wire-drawing mechanism, including the drawing pulleys, lies in one common water tank so that the entire process of drawing goes on under water. This tank can be lowered by a hand lever so that it is possible at any moment to liberate the drawing mechanism with a single movement of the hand in order to ascertain its condition. The die-holders are so constructed that the wire is passed to the drawing pulleys in a straight line. The wire thus encircles all the drawing pulleys for only three-quarters of their circumferences, except in the case of one pulley on which the winding covers somewhat more than the circumference, so that it is impossible for the wires to become entangled or cling to one another and break. The drawing pulleys have three grooves of different diameters, and hence three wire-drawing dies can be used. The ready drawn wire after passing through a short bath is wound on a collecting drum having detachable flanges; and these drums with the wire on them are placed in the annealing furnace, but the wire can also be wound on a drum in the usual way, from which it is removed in coils. The ma-

* For additional information on the subject of wire drawing published in MACHINERY see "Wire Drawing," October, 1912, and "The Making of Seamless Gold Wire," March, 1911.

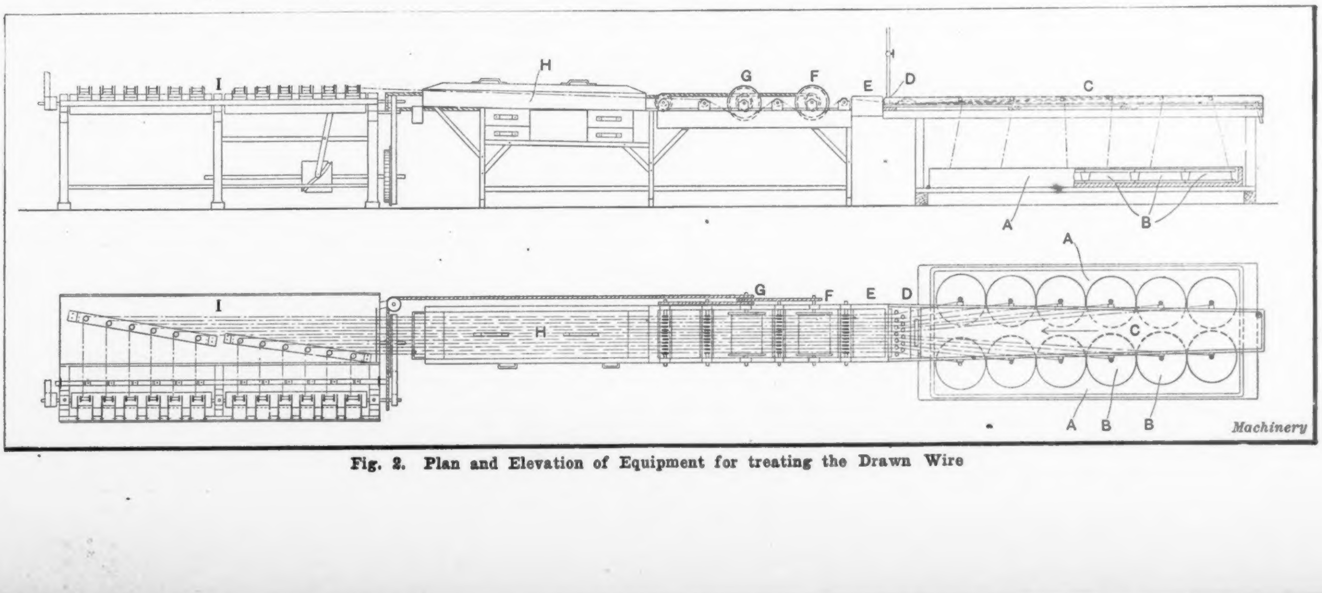

Fig. 2. Plan and Elevation of Equipment for treating the Drawn Wire

chine is also fitted with a mechanism enabling it to stop automatically when the wire breaks.

It may be pointed out in this connection that as the whole drawing process takes place under water, the wear on the drawing pulleys and dies is evidently reduced to a minimum. Skilled workmen are not necessary, and young workers can be employed almost exclusively. They have no influence on the ultimate condition of the wire, as they only handle it in the crude state. The collecting drums on which the wire can at once be passed into the annealing furnace have a capacity of 33 pounds. The space occupied is much less than with machines hitherto used; and the air in the workrooms is not filled with metal dust, so that the work is healthful. The precipitated dust is recovered in the form of slime. The drawing process insures uniformity, which is important for wires such as phosphor-bronze warp wires.

The use of this continuous wire-drawing machine is followed by the further process for the treatment of warp wires. A number of the collecting drums, which are easily detachable from the drawing machine after being filled up, are passed into an annealing furnace, and the wire is annealed on these drums. The latter contains, as previously stated, about 33 pounds of wire, and therefore there is no need to break off the wire after coiling up 5 or 7 pounds, as was formerly necessary. After annealing, the set of twelve collecting drums is plunged into a common acid bath, and the wire is then drawn off them. The drums taper toward the top so that it is easy to draw the wire off. The wire, first of all, passes through a channel in which fresh water flows continuously, in the direction opposite that of the wire. Then the wire passes through a sand bath in which adhering acid residues and the like are rubbed off, after which it passes through a tartaric acid and water bath. It now passes through a long drying box filled with sand, which is heated from below, from which it emerges bright and uniform, ready to be wound up by the winding machine without any waste. The collecting drums are made of manganese bronze, and can stand from 150 to 200 annealing processes.

Fig. 2 shows in plan and elevation the apparatus just described, in which *A* is an acid bath containing the collecting drums *B*, from which the wires pass upward to the washing bath *C*, and then through roller guides *D* into the sand box *E*; thence to the tartaric acid bath *F*, and the final water bath *G*. The drying apparatus is shown at *H*, and *I* is the winding machine. It will be seen that the whole process is so simple and mechanical in its action that it requires but little attention, and the saving in wages is considerable. It should be especially noted that all waste of material, which is so marked in the use of loose wire rings, is thus avoided, and also that the quantity of acid and other substances used is considerably reduced. A special advantage is that every wire is separately cleaned and dried, thus insuring uniformity in color and, above all, in quality. In some of the older processes, this uniformity cannot be absolutely guaranteed. Moreover, as the operator has practically no hand in the process, carelessness or poor judgment have no effect. The certainty of success is therefore greater and the output of good wire higher. The ultimate yield is a long unbroken wire thread. Naturally, the use of the continuous wire-drawing machine is not reserved to the whole process for the further treatment of the wire, as the machine can be used without the subsequent process. As already mentioned, a take-up drum, otherwise used for coiling the wire, is fitted on each machine, and it is used particularly in the production of soft weft wires for weaving purposes. The whole plant appears to place the production of metal wires on an advanced basis and is therefore worthy of attention.

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A mechanical idea may often be carried out without drawings, but the process is usually costly, and unforeseen errors or interferences require changes after part of the machine or device has been made. There is danger of careless thinking and a trusting to luck which is unsafe and demoralizing. Drawing, as a rule, requires logical thinking. It is furthermore a record of the thinking and is invaluable in the case of improvements and repairs.

THE "PATENT-BEE"*

BY H. W. WEISGERBER†

Where is the man who has not heard a "patent-bee" buzzing under his hat? That there are such, I know; but I also know that there are hundreds and even thousands, or tens of thousands, of poor deluded souls (who were not as wise as Ulysses of old, who stopped the ears of his sailors so that they could not hear the enticing songs of the Sirens), who when they had put in their all, found themselves financially wrecked upon the patent office shoals. What is there so enticing about a patent? Do they expect to find a short route to wealth and fame, or is it because they have heard tales of fabulous wealth being made out of some simple device? And do they imagine that they, too, can find a fortune if they but invent something, no matter how simple or useless it may be? A patented article, if there is no immediate use for it, is about as worthless as the sands of the seashore. Then, too, it is worthless if it cannot be manufactured within a reasonable price; or sometimes a seemingly useful article must have a fortune spent upon it to properly advertise the usefulness of it and to bring it to the attention of the people.

Edison will always be as a shining light that the patent attorney shark will hold up to the would-be inventor; but, whereas we have one Edison in this country, we have about one hundred millions of the common people, and does each one out of several thousand patentees imagine that he or she can become a second Edison by inventing some simple thing that any boy in a manual training school can make with a saw and hammer? One has only to look through the patent office records to find that farmers are among those who, whenever they think up some simple contrivance, rush with it to the patent office and take out a patent that costs them no less than a hundred dollars; whereas if they would write it up and, with a sketch for an illustration, submit it to some farm paper (where no doubt it would be accepted) they would be ahead a dollar or two, instead of being out of pocket a hundred and over. But, having lost on one thing they don't always stop, but continue to get out others in the hope of recovering what they have already lost and, like the gambler, they expect their luck to change and that they will catch the will-of-the-wisp that will show them to a fortune.

It is a well known fact that most inventors die poor, while others, if they have had money to start with, have gone "broke," and lost that which they had. To the uninitiated the patent office is not much more than a delusion and a snare; while the large concerns who take out patents that are of real value, must often take their claims to court and carry the case from one court to another, and sometimes to the highest court, before they are certain that they own the patent on their product. This should not be necessary, but it is so, nevertheless. I am not saying anything about the mechanical engineers who take out patents, but even they invent many costly machines from which they never realize enough to pay for the patent; nor am I saying anything against the manufacturer who wishes to protect his products against infringers, but I am warning the everyday mechanic and the man or woman in moderate circumstances, who have only their daily wage upon which to live, that they may not foolishly squander their money upon anything as uncertain as a patent.

If you have anything of real value there are honest manufacturers who would be only too willing to pay for the patent and allow you a royalty; and if they were not honest, and you had the patent in your own name, they would somehow manage to get it without paying much or by taking some of the ideas and making a new article. Then, as you would not have the money to carry a case through the courts, your invention would be useless. But there are many people who wish to add to their meager incomes, and seeing under the classified advertisements in the Sunday papers long lists of inventions that are wanted, and thinking that

* For additional information on the subject of patents previously published in MACHINERY, see "Patents from a Patent Attorney's Viewpoint," September, 1914; "Filing Your Own Patent," July, 1914; "The Value of a Patent," July, 1914, and articles there referred to.

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they too can invent some of them, write for "particulars and circulars" to the advertiser, and receive printed information that will lead them to think that a fortune is waiting for them just as soon as they get their "patent." Not long ago I received a circular letter from one of these sharks (he had seen my name and address in a mechanical journal) offering to let me in on reduced rates and a good per cent of the fee on all work that I could send him by referring my friends to him with their patent business. I recently heard an inventor —a mechanical engineer who gets his living from his inventions—say that his name never appeared in a patent list, but that he received a heavy mail of letters from these sharks asking him for his business.

That patent attorneys take anything and everything that a client may offer, there can be no doubt, for how else could it happen that the pages of the "Record" are filled with so many trivial and seemingly useless inventions? I once worked with a draftsman who claimed to have worked for a firm of patent attorneys, and he never tired of telling how they used to "fix" the "hayseeds," as he called them, who had "inventions," which they wished to patent. They would first finish a drawing and then "just happen" to think of some important changes, and of course the "bait" would catch and the drawing would have to be done over, making more work for the draftsman. Or they would apply for a patent and then (?) think of something else, always important, and that would mean an extra fee and more drawings; and thus they would keep it up and keep their client in the city just so long as his money lasted.

This calls to mind the case of a Danish farmer I knew in my boyhood days, and whose farm adjoined that of my uncle's. He imagined that he had a valuable invention in the shape of a potato-digger; it was just an ordinary shovel plow with a row of tines at the rear (just such a "digger" as is on the market now) and, no doubt, he imagined his fortune already made. His neighbors joked and laughed about "Jim's potato digger." Anyhow by the time he finished inventing, he had lost two farms. I well remember seeing his house and yard littered with large sheets of paper, for he was not draftsman enough to make small scale drawings, but he had to draw everything out full size. Then, instead of making a drawing and letting some mechanic make his "digger," he went to a village blacksmith who could neither read nor write and who could only work at it in spare time; so "Jim" had to put in his time and superintend the construction, which was, too, one of the cut-and-fit order. Being four miles from town was a little too far for convenience sake, so he moved to the village into a rented house; then, with nothing but expense and with nothing coming in, and with one patent following another, his cash was soon exhausted and his "invention" a failure.

A farmer's "inventions" as they appear in the official record can generally be told from those of a mechanical man, for they are usually made of wood instead of iron or steel. Fifty years and more ago all inventions were of a very simple nature, for mechanical engineers as we find them today did not exist. Times have changed. All appliances must be made of iron or steel as far as possible. Without mechanical training one cannot well get up a worthy invention, for it is hard to convey ideas to someone else, and if somebody else will have to do the head work they will also expect the reward. This calls to mind an incident that occurred several years ago when the suction sweepers were beginning to flood the market. A traveling man, who may have had an idea in mind, came to our place and wanted to know if we could make a drawing of an air pump for him. Of course, we would be glad to do it, if he knew what he wanted, but he either thought that we wanted to steal his idea or that we did not know how to make the drawing, for it was impossible to get anything out of him, save the fact that he wanted an air pump drawing. The trouble was that he wanted someone else to work up the design, for if he had an idea he was unable to convey it to others.

The average person has not the least idea of the growth of the patent business during the last two decades. I have access to a library of patent office records that extend back nearly 70 years. During those early years the annual report of patents issued did not form a book much larger than Webster's Academic Dictionary; now the business for three months fills a book larger than a Webster's International Dictionary. It is simply astounding, because a great many of the devices are useless and impractical. It should always be borne in mind that as soon as a successful invention appears there are always a multitude of imitators, so that unless one has the means to carry on the manufacture of that which he invents, or is willing to accept a small per cent of a royalty, he should not risk his all on the price of a patent.

Scarcely a week passes that the firm for whom I work does not receive an appliance of some kind on engines from inventors, but as yet they have never found anything of real practical value to them; yet, whenever any device is needed it is always worked out satisfactorily, and not patented either. And right here let me say that if every manufacturer went to the patent office for a patent for every idea and improvement, there would not be any profits left for the stockholders. It is not necessary to run to the patent office with every idea. If you have anything worth while, make a drawing and sign your name, address and date, and then have three of your friends witness it by doing the same; then go ahead and work up your invention, and if anyone else applies for a patent on the same thing, you will at least have good evidence for a priority claim when you apply. An invention is an evolution, and it is impossible to think of all the good things at first; so an invention either grows more simple than at first, or it becomes more complicated so as to extend its usefulness. To take out a patent in each step of the process is very expensive, especially if a few months of thinking and experimenting will help to improve it and so that all can be included within the one application. I know of machines for which patents had not been applied for until a year after they had been built and tried out, and improvements made upon what they were originally.

Few people realize that it often takes a small fortune to develop and place on the market a useful article. So instead of selling their idea for a small, reasonable sum, or by offering one-half of the patent and letting the manufacturer pay for the patent and taking a small royalty for their share, they expect a fortune the first thing. It is said that railroads are willing to wait until a patent expires before they will allow themselves to be held up for an invention. So don't patent anything that the patent sharks say is wanted; for the chances are that if it is possible to invent it, many patents have already been taken out and so yours would only add to the number of failures and your cash go to swell the sharks' amount of spending money. But if you must patent your ideas go to some manufacturers in your community or vicinity and in that way secure the name of some reliable attorney. In doing so you will at least have the satisfaction that you are not being duped.

* * *

It is estimated that there are at least 50,000 amateur wireless telegraph operators "butting in" all along the Atlantic coast, and it is stated that in many cases they drown the long distance over-sea messages. The *Compressed Air Magazine* states that this condition has become such a nuisance that regular operators cannot count on long distance work until after midnight when the air becomes clear. Besides being a bother, this promiscuous sending of messages gives opportunities to practical jokers who send fake messages. They are practically immune from prosecution, as there is no way to prove the source of the message.

* * *

Contributors are frequently advised to start articles with a general definition of the subject treated and a brief review of what the article is intended to set forth. Sometimes, however, authors go to the extreme in defining the obvious; the following definition of an elevator given in a paper on "Elevators—Their Uses and Abuses" before an engineering society is worthy of being recorded: "An elevator may be termed an ingenious mechanical device, invented and designed by man, to overcome nature's imperative law—the law of gravitation."

ABRASIVE PAPER AND CLOTH MANUFACTURE

MACHINES USED BY THE CARBORUNDUM CO. FOR APPLYING ABRASIVE AND CUTTING THE COATED STOCK

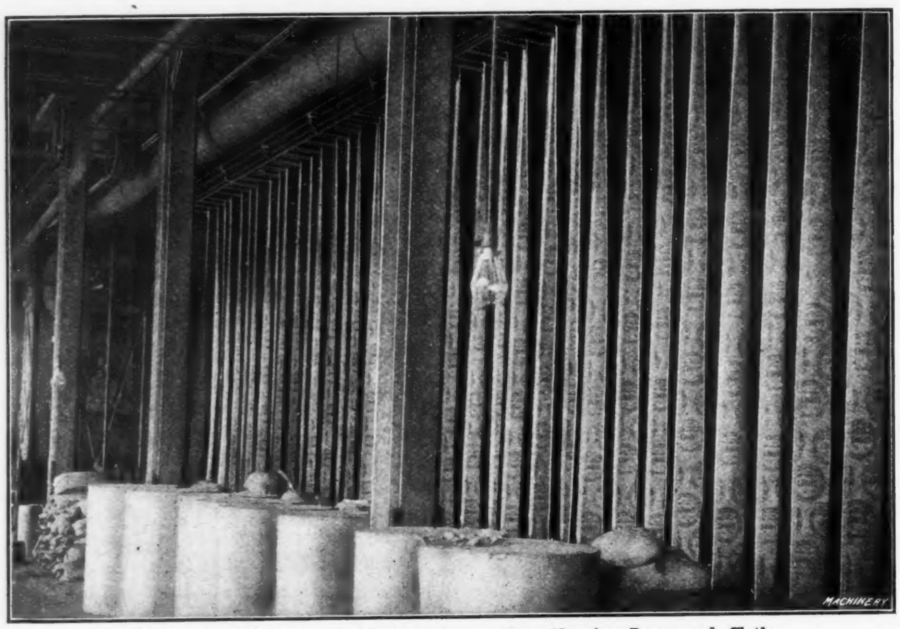

Fig. 1. Partial View of Machine for coating Abrasive Paper and Cloth

THE manufacture of abrasive paper and cloth is a more extensive and interesting process than would be inferred from an inspection of the finished product. First, there is the production of the abrasive, second the application of the abrasive to the paper or cloth, and third, the cutting of the coated stock into strips, squares, disks or special shapes such as are required by shoe manufacturers, etc. The various classes of paper and cloth manufactured by the Carborundum Co., Niagara Falls, N. Y., are coated with three different abrasives, *viz.*, garnet, carborundum and aloxite. Garnet is used in woodworking; carborundum, for finishing leather goods (especially in boot and shoe manufacture) and in disk form on disk grinding machines; whereas aloxite is more particularly adapted for general machine shop work. As is well known, both carborundum and aloxite are artificial abrasives, whereas garnet is a natural product. In this article, the method of coating cloth and paper with an abrasive and the cutting of the coated stock into commercial shapes will be described.

The principal problem connected with the manufacture of abrasive paper and cloth, aside from the production of the abrasives, is that of drying the glue which holds the abrasive grains in place. In order to coat the stock efficiently, the process must be continuous, and as the coating is done quite rapidly miles of coated stock accumulates before that which first passes the coating rolls is dry. The way in which this stock is automatically stored while drying in one continuous length is the most interesting part of the process.

The path followed by the stock from the time it is unwound from the roll at one end of the machine until it is again wound at the other end, after having been coated with an abrasive, is as follows: First the stock passes between circular rolls which print on one side the name of the company, the kind of abrasive used and its number; it then passes between two rubber rolls, the lower one of which is immersed in a tank of hot glue. The coat of glue, which is deposited on one side, is next spread evenly by a narrow brush which extends across the stock and has a very rapid reciprocating movement. Just beyond the brush there is a hopper, from which an even stream of abrasive falls upon the stock; the latter then passes under a steel roll which forces or imbeds the abrasive grains into the glue, holding them firmly on the stock.

The paper or cloth next passes over an elevated drum and is then gathered up into loops about 12 feet long by an endless chain mechanism, which at regular intervals carries a wooden cross-bar up under the sheet as it feeds out. When one of these sticks upon which one of the loops is suspended is conveyed to the top, it enters upon a horizontal track and is conveyed along by a slow intermittent motion so that the first coat of glue will have time to partially dry before the next coating operation. This intermittent motion is obtained from a framework that extends above the track and moves back and forth. The stroke of this frame is about 12 inches, and with each forward movement pawls on it engage the cross-bars upon which the loops hang and push them forward a distance equal to the stroke of the frame. On the return stroke, the pawls simply lift and glide back over the sticks and then engage another set on the next stroke. As the result of this intermittent movement, the loops of cloth or paper swing to and fro as they gradually move along, presenting a rather grotesque appearance.

About one hundred feet from the starting point, the paper which has partially dried passes through a second glue coating process. This is known as "sizing." The glue is much thinner than is used for the first coat and is applied to fill up the interstices between the abrasive grains and hold them more firmly in place. When one of the loops approaches this second or sizing machine, it is straightened out as the paper is drawn between the tensioning and gluing rolls and this straightening out draws the loop cross-bar (which has

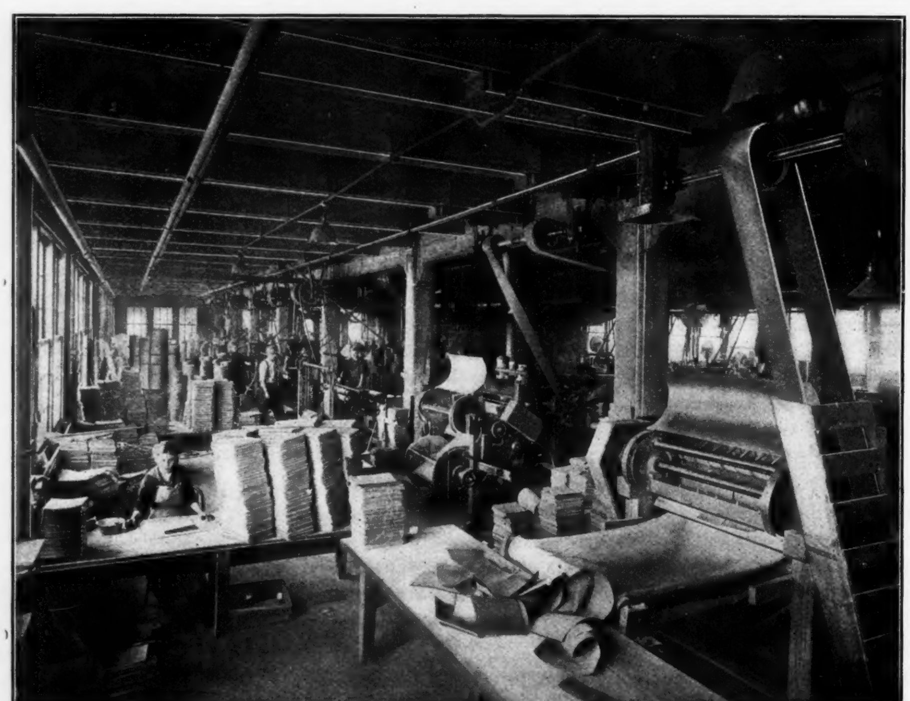

Fig. 2. Department where Paper and Cloth is cut and formed into Various Shapes

passed beyond the feeding pawls) forward, and the cross-bar drops upon conveyor chains and is lowered to the floor.

The paper, after passing the point where the cross-bar support is removed, is drawn over a curved platform down to the tensioning rolls and then to the second set of gluing rolls. After the sizing operation, the paper passes over a drum or roll, on the periphery of which are raised strips that incline from each side toward the center, similar to the teeth of a herringbone gear. This roll is to center the paper before it again enters upon the drying track. The paper is now gathered up into loops upon cross-bars which are automatically elevated at proper intervals, the arrangement being the same as that used after the first coating process. This endless chain conveyor for the cross-bars is partially shown at the top in Fig. 1, the movement of the coated stock being toward the observer.

The loops of coated paper now begin a long journey which continues in a straight line to the end of the room, the motion being intermittent and effected by the feed pawl mechanism previously referred to. When the procession of swinging loops reaches the end of the room it makes a short turn on a curved track and proceeds back in the opposite direction. The feed of the cross-bars around this curved end is obtained by a pawl feeding mechanism similar to that described except that it is curved to conform to the track, and this curved fan-shaped frame has an oscillating movement instead of a straight-line motion.

After passing the curve, the loops, which hang quite close together, as Fig. 1 shows, travel in an unbroken line and on a continuous track from one end of the building to the other several times. At the end of the last track the supporting cross-bars fall onto another chain conveyor and are carried down to the floor. The stock is then drawn over another curved platform, just beyond which there is a series of rolls which iron out the wrinkles and also provide tension preparatory to winding the coated stock onto an arbor. This is the end of the coating operation.

The complete passage from the first coating rolls to the end where the coated and dried stock is wound onto rolls requires several hours. When the tracks are completely filled with paper, they hold a continuous sheet (joined by glue where breaks have occurred or where a new roll of paper has been started) which, if straightened out, would extend about eleven miles.

The coating process is practically the same for cloth as for paper, except that the cloth stock requires two passages through the coating machine, one for coating with glue and another for coating with both glue and abrasive. A preliminary coat of glue is necessary because the cloth absorbs more glue than the paper. Stock varying from 18 to 48 inches wide can be run through this coating machine. When a lot of paper or cloth is to be coated, the wide stock is put through first, the order being from wide to narrow. This is done so that any wear which might occur on the rubber glue coating rolls will not affect the narrower widths. Similarly, stock requiring the coarse abrasives is coated last, the order being from fine to coarse to avoid any possibility of coarse grains which might have remained in the machine being deposited upon a paper of finer grain.

The large rolls of coated stock are cut into various shapes in another department, a general view of which is shown in Fig. 2. At the right of this illustration is one of the machines used for cutting the stock into squares. A roll of coated cloth or paper is fed into this machine and first passes between the edges of cast steel wheels which split it into several narrower widths. As these narrower widths continue to feed forward, they are cut into squares by a single revolving knife or blade. The relation between the speed of this knife and the feeding movement of the stock is such that suitable lengths are obtained. The splitting wheels used on this type of machine resemble small cylindrical pulleys and operate in pairs, that is, the pulley rims are set close together to form a shearing roll. Other machines in the department which are simply used for splitting into narrow widths have circular knives or narrow sharp edged blades which engage grooves in another roll and the stock is split by feeding it between the rolls. These narrower widths are afterward wound into rolls for shop and factory use.

Circular disks such as are used on disk grinders are cut by two different methods. Small and medium sizes are blanked out in a press equipped with dies, whereas large disks are cut by shearing wheels similar to those previously referred to, which impart a circular motion to a square of stock that is rotated about a central pivoting device.

Owing to the varied use of abrasive cloth and paper at the present time, many odd shapes are required such as small circular pads, convex belts for special leather finishing machines, etc. The production of these irregular shapes involves the use of special tools and constitutes an important branch of abrasive cloth and paper manufacture at the plant of the Carborundum Co.

* * *

NEW METHOD OF PRODUCING HOLLOW BARS

A new method for producing hollow bars is described in *Page's Engineering Weekly*. The production of hollow metal bars with a hole through them from end to end has hitherto only been possible by drilling. By a hollow bar is meant a bar with a comparatively small hole in the center and thick walls, in contradistinction to tubes, which have a large hole and thin walls. The need for hollow shafts in almost all branches of engineering is generally admitted and elaborate machinery is constructed to produce them. The cost of deep hole drilling, however, is great and, in many cases, almost prohibitive, and the difficulties and cost of production limit the application of the hollow bar principle, so that designers are forced to avoid this construction as much as possible, using instead roundabout and complicated designs.

By a recently patented process, owned and worked by Dunford & Elliott, Ltd., of Attercliffe Wharf, Sheffield, England, it is now possible, however, to obtain long bars with a small hole from end to end. As an example, a 3/4-inch bar, 30 feet long, can be produced with a 1/4-inch hole from end to end. The process is briefly described as follows:

The billets or blooms are drilled with a hole from end to end. This hole is afterward packed tight by a special composition, the ends are plugged up, and the bloom thus prepared is elongated in the rolling mill to a bar of the desired dimensions, the packing being also simultaneously elongated in exact proportion to the metal. This packing, or core, is afterward removed by high pressure liquid, which is caused to impinge on the material to be removed. In this way long bars in rounds, squares, octagons, or hexagons, are produced. The hole, though not mathematically circular or central, is true enough for a number of engineering purposes, and where greater accuracy is required, as, for instance, in spindles, it is a comparatively simple operation to ream out the hole, in which case the hole produced by the process described merely serves as a pilot hole. Mechanics will readily appreciate the great advantage derived from being able to lubricate the cutting edge of the drill from the opposite end. Any kind of iron or steel may be treated, from the most expensive alloy steels to the common basic grades.

The process is not merely in an experimental stage, thousands of tons of these hollow bars having already been produced. The process was originally devised to supply the demand which was gradually making itself felt for hollow mining steel, the cost of which was prohibitive by the old method of producing by drilling. Large quantities of mining hollow drill steel have already been produced, and the demand is rapidly increasing, since the advantage of the hollow bar for mining drills is beyond dispute.

* * *

"CHILLS" FOR CAST-IRON CALENDER ROLLS

Chilled rolls for paper calenders, etc., are cast vertically in cast iron "chills." The chills are made in sections about thirty inches long with flanges at each end. Odd lengths are provided so that any desired length and diameter of roll can be cast. The Lobdell Car Wheel Works have many hundreds of these chills in all commercial diameters. Each section is bored and faced and is provided with trunnions in the center for convenient handling. The investment aggregates many thousand dollars.

MAKING A SET OF SINGLE TYPE ARMATURE DISK NOTCHING TOOLS*

KINKS FOLLOWED IN MAKING "FINGER DIES" FOR NOTCHING ARMATURE AND FIELD DISKS IN THE GENERAL ELECTRIC CO.'S LYNN PLANT

BY CHESTER L. LUCAS†

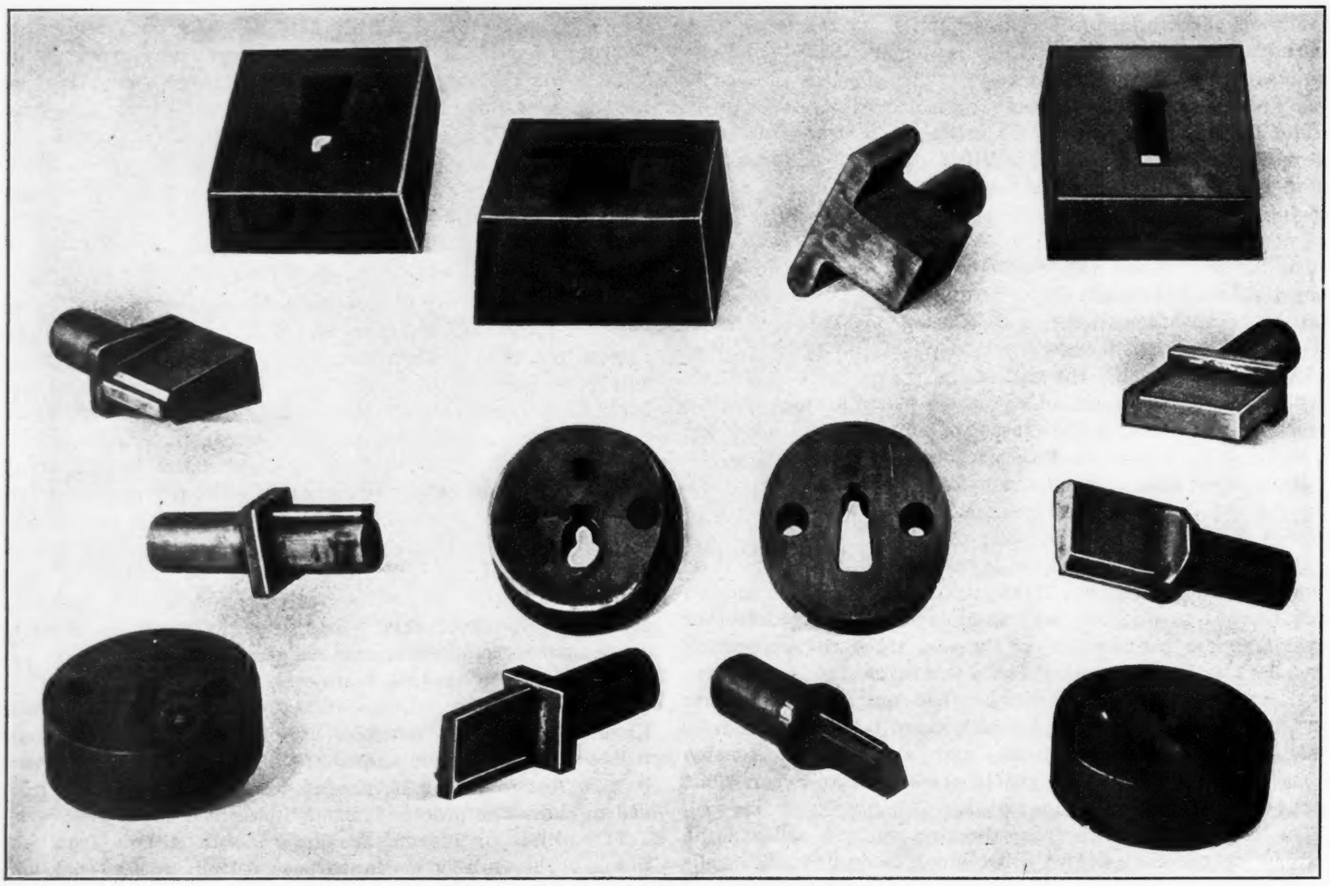

Fig. 1. Punches and Dies for Armature Notching

ON account of the large number of armature disk notching tools of the single type required in the General Electric Co.'s plant at Lynn, Mass., the work of making the dies has been specialized and the operations reduced to the lowest possible number. This class of die-making, while simple in theory, requires a high degree of skill in order to produce the tools rapidly and accurately.

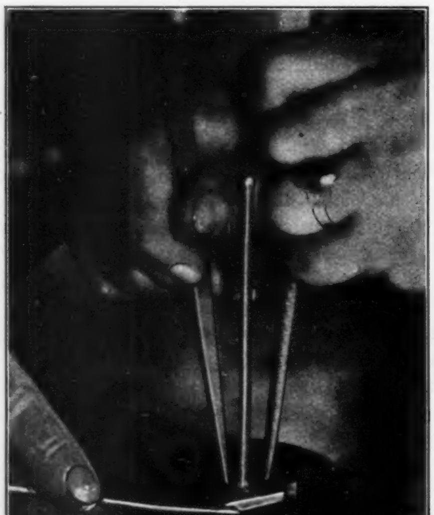

Fig. 2. Scribing the Outline of the Templet on the Die-blank

After the drawing has been made for a new armature disk and the size of the winding hole slots, as the notches are technically called, has been figured out by the engineering department, a detailed drawing showing the slot itself and its position on the blank is sent to the diemaking department. One of these drawings is represented in Fig. 4. To those not accustomed to this class of work, it seems strange that the dimensions of the slot must be held so accurately. As a matter of fact, a variation of over 0.002 inch is enough to condemn the die. The diemaker makes his templet from the detailed drawing of the slots. One of the methods followed in making the templet is to use a piece of ground tool steel stock, about 1/8 inch thick. After the surfaces have been finished on the surface grinder, the steel is blued by heat and the outline laid out from a center line. The principal dimensions are obtained by setting a pair of dividers to one-half the distance required and scribing it from the center line on each side. If there are any curved sections in the outline, they are put in from a center point which is first accurately located. The outline of the templet, when scribed in and ready to be cut out, has the general appearance shown in Fig. 6.

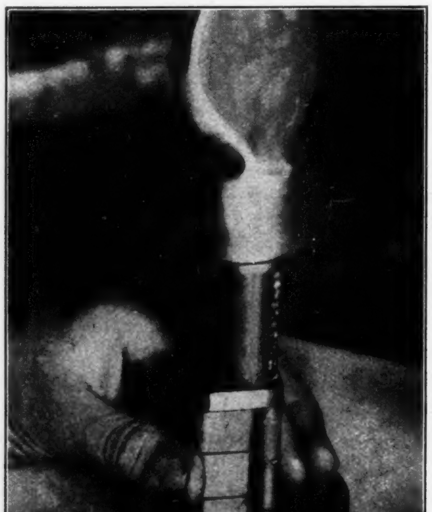

Fig. 3. Fitting the Punch

It is, of course, important that any measurements struck off with the dividers from the center line be accurate. Three

* For articles on making armature disk notching tools previously published in MACHINERY see "One-piece Armature Disk Tools," March, 1914; "Indexing Tools for Notching Armature and Field Disks," September, 1914.
† Associate Editor of MACHINERY.

methods are commonly used among diemakers for setting dividers accurately. One is to set the dividers as close as possible to scale measurement. This distance is then spaced off, say, ten times on a scribed line on a piece of brass and the total length measured. If the total length shows no multiplication of error, the setting of the dividers is correct. Should the total measurement register longer or shorter than standard, the dividers are changed, accordingly, one-tenth the amount of the error. The second method of setting dividers accurately is by using a Brown & Sharpe "improved graduation" rule. By means of a magnifying glass and this rule, a pair of dividers may be set very accurately. A third way of setting dividers to accurate measurements is obtained by using a vernier caliper. The center points on a vernier caliper are always a prescribed amount in excess of the reading of the caliper; therefore, by making the proper allowance, the dividers may be set from the caliper. With the magnifying glass and ordinary care, a good workman can set a pair of dividers with a scale graduated to hundredths of an inch as close as 0.002 inch.

The templet is next sawed from the sheet of steel roughly —under no circumstances is chipping resorted to—and then filed to the line. At every point where the measurement can be checked by the micrometer this is done. At the corners, for instance, where there is usually a curve, the templet is

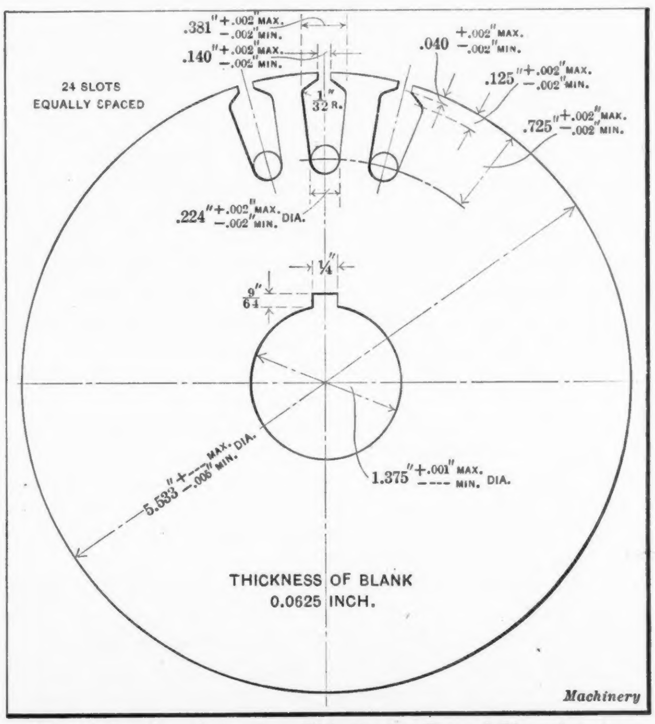

Fig. 4. Drawing of Armature Disk showing Type of Dimensions to which the Dies are made

first filed straight out to a point so that the measurement across corners can be taken before filing away to the curved outline. The curved ends of opposite sides of the templet may be readily checked by means of a radius gage. As the templet is ⅛ inch thick great care must be taken to have the filing done squarely with the face of the templet. A hardened and ground block is held in a vise; the templet is clamped to the top of this block and the diemaker files by the square side of the block so that the templet is absolutely square. This is far better than using a square free-hand.

Finger dies are of two types, round and square, both of which are shown in Fig. 1. In die-making, the same methods are employed for both, the principal difference being that the round die-blanks are only about half the thickness of the square dies. Of course this makes the square type of die the more difficult to work out. The templets are usually made by the same man, especially trained on the work. The diemaker is given a die-blank, the surface of which has been ground off and blued and is ready to have the outline of the templet scribed upon it. He first takes the templet and solders a piece of drill rod about one-eighth inch diameter and four inches long at the center of the back. This is to facilitate handling the templet while fitting the die to it. The next thing the diemaker does is to scribe a center line upon the die-blank. The templet is then laid face down upon the die-blank in position so that its center line will coincide with the center line of the die-blank. Fig. 2 shows the method of holding the templet in place with two files while the outline is being scribed. As the illustration shows, one man bears down with the two files upon the templet while another man scribes the outline, keeping the sharp scriber very close to the edge of the templet. Another and better method of holding the templet to the die-blank while the scribing is done is illustrated in Fig. 5. This shows a special dis clamp being used for holding the templet. This clamp is also useful in holding the punch-blank to the finished die when laying out the punch.

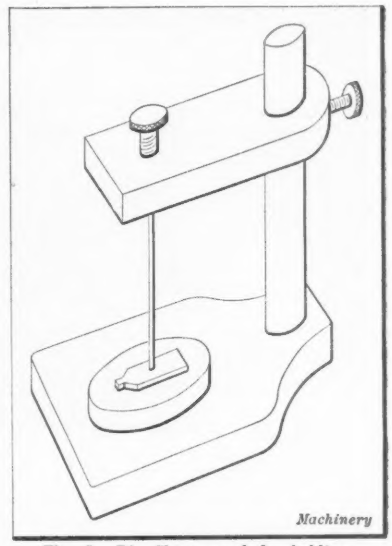

Fig. 5. Die Clamp used for holding Templet to Blank while marking

Cutting the Opening

In cutting the opening in the die, the procedure is the same as in other die-making operations. The outline is drilled, taking care to first drill out any radius sections with drills of the proper diameter, following up with the reamers to give the necessary clearance of one-half degree. After drilling the outline, the core is chipped or drifted out and the steel is taken out with coarse files nearly to the scribed outline, as shown in Fig. 7. As the filing approaches the outline, the templet is tried from time to time until it starts to enter from the rear side of the die. From this point on it is a case of taking away the high points so as to let the templet through evenly. Great care is taken to keep the filing as nearly straight as possible, and under no circumstances should the opening be allowed to become larger at the face side. When the templet has been entered in the opening of the die to a point half way to the face, finer files should be used. On this operation the filing machine is used to great advantage. The table of the filing machine may be set so the filing will be straight or so the desired amount of clearance is given. Gradually, the high spots are taken down until the templet can be pushed in from the back clear through the opening flush with the face of the die-blank. The manner of trying the templet is shown in Fig. 8. If the die has been properly made, the insertion of the templet in this manner will completely shut out the light. By the

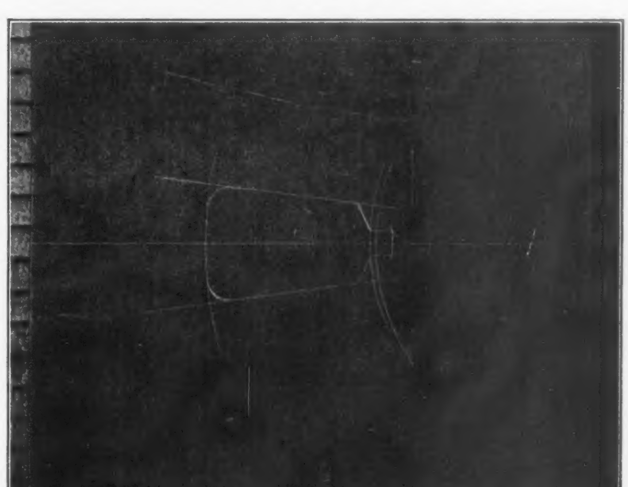

Fig. 6. A Templet Outline scribed on the Steel and ready to be cut out

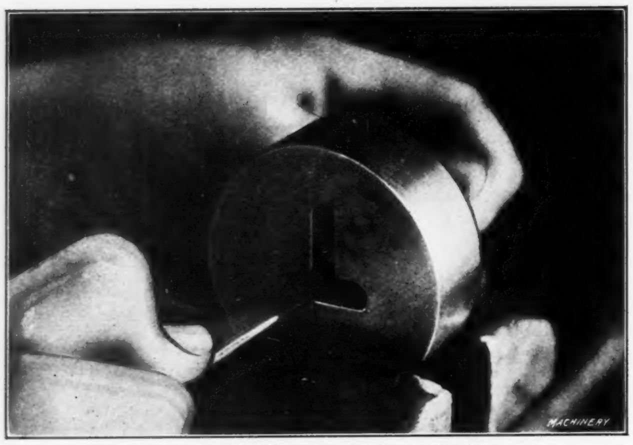

Fig. 7. Rough-filing the Outline in the Die

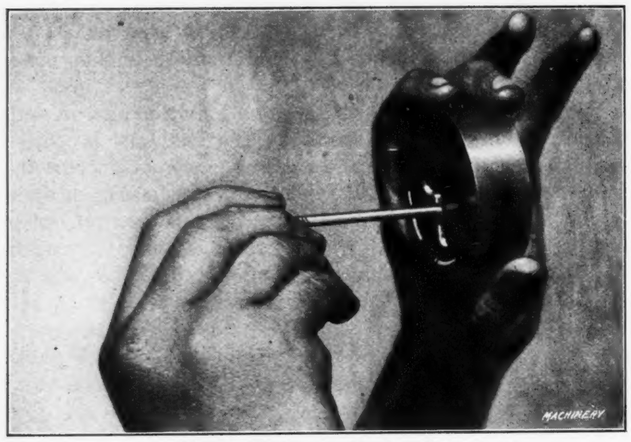

Fig. 8. Trying in the Templet

proper use of the filing machine, all danger of filing the die out of square will be eliminated. The die is tested for clearance from time to time as shown in Fig. 9, using a small die-square. The correct clearance is one-half degree in all sections of the die.

The Allowance for Shrinkage in Hardening

After the clearance has been put in all around the die, the allowance for hardening is made. This allowance varies with the thickness of the die-blank, the general size of the opening, and the proportions of the opening. In the case of a die made from a templet such as may be seen scribed on the piece of stock in Fig. 6, the allowance for hardening would be about 0.001 inch for width and 0.0015 inch for length. This means that the die will shrink this amount in hardening and that the opening must be correspondingly increased in size by these amounts so that the die when hardened will fit the templet. In hardening, there is a tendency for the sides of the die cavity to bulge; therefore it is customary to concave these sides slightly to offset this trouble.

While the time for making a die of this kind varies with the intricacy of the outline, and the size and thickness of the blank, it is approximately seven hours' work on the average shape. This only includes the putting in of the opening and has no reference to the fitting of the punch.

After the countersunk holes have been drilled at the sides of the opening in the case of round dies like those shown in the center of Fig. 1, they are filled with fireclay or wet asbestos, and the die is then ready for hardening. The hardening temperature depends, of course, on the grade of steel being used, but after the steel has been brought to the proper heat and is ready for quenching, it is plunged, always face down, into the brine tank. Here it is left until it is nearly cold—the length of time usually being judged by the rapidity with which the water evaporates from it when it is temporarily taken from the tank. Considerable heat still remains in the die, and with emery cloth and stick the face is polished off and it is put on the tempering plate and drawn until it has reached a straw color. The reverse side and the face of the die are now given a "once over" by the surface grinder and it is ready for the fitting of the punch.

Making the Punch

The punch-blanks are turned up from square, oblong or round bar stock, according to the shape of the die opening. The different sized blanks are kept in stock and the diemaker simply selects one which conforms most nearly to the shape of the templet he is working to. The face of the punch-blank is coppered and the outline of the templet scribed on it. The outline of the punch is roughed out to 1/64 inch of the line at all points on the vertical milling machine, using a special punch-holding attachment. If a workman is careful, he can follow the line of almost any punch on the vertical milling machine, bearing in mind that the punch-holding attachment can be swiveled so as to work with the end of the cutter or the side, whichever best suits the case. The diemaker takes the roughed-out punch and shears it into the die under a screw-press. It is only necessary to enter the punch 1/16 inch or so at this time. The "witness" that the shearing operation leaves on the punch is the guide by which the finish-milling is done. The finish-milling is done in exactly the same manner as the rough-milling, except that on this operation the stock is milled away until it is almost even with the sheared-in section. The diemaker now takes the punch to the vise and files away the slight amount of excess stock so that the punch can be driven through to the shoulder. The punch is sheared in for the full length under a screw-press. Then the punch is coppered for its full length and, as shown in Fig. 3, is tapped through the die. This operation leaves the coppered surfaces marked at the places where the punch needs "easing."

The final filing operation on the punch is illustrated in Fig. 10, below. On this class of work it is essential that the dies have a grinding life of very nearly an inch in the case of the square blank type, and the punch must have a working section of at least an inch and a quarter—an inch and a half is better. The punch is hardened and drawn to a very dark straw color and its face ground. After using the die for shearing in, it is necessary to regrind its face. On this work, no strippers are fitted to the punches. Either a stripper that can be set up and adjusted for the work on the press is used, or the more simple form composed of layers of India rubber fitted on over the punch is made use of.

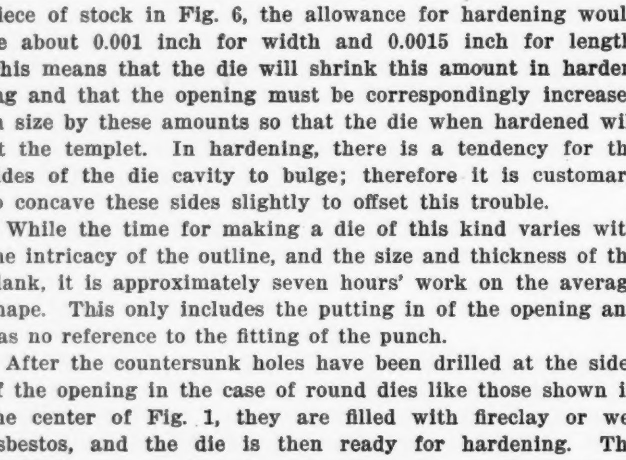

Fig. 9. Testing the Die for Clearance

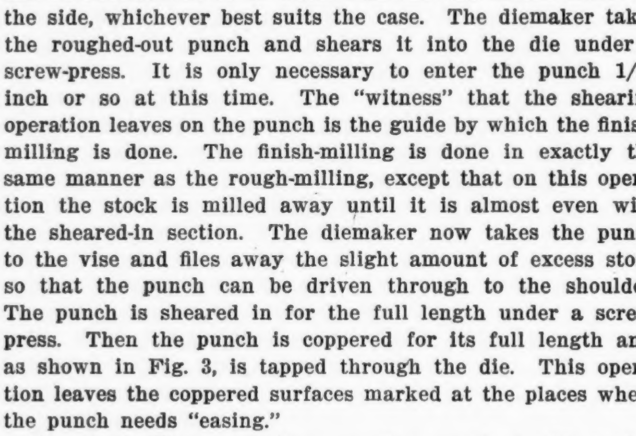

Fig. 10. Relieving the Punch after it has been fitted

SELECTION OF WHEELS FOR CYLINDRICAL GRINDING

CONDITIONS WHICH DETERMINE THE SUITABILITY OF A WHEEL FOR GRINDING ANY PARTICULAR CLASS OF WORK

BY F. B. JACOBS*

THE grinding room foreman, and the purchasing agent of any concern where the grinding machine is depended upon for accurate and economical results are interviewed very frequently by grinding wheel salesmen. As a salesman's duty is to sell goods, of course, each and every one has just the wheel that will surely reduce production costs. All salesmen are convincing talkers, which is one reason why they are salesmen; therefore, they have many arguments in favor of their goods. However, as one salesman's assertions almost invariably upset not only the theory but the logic of the previous salesman, it is no wonder that the selection of grinding wheels is often looked upon as a complex problem. There are some thirty grinding wheel manufacturers in this country, but of that number there are only a few who supply wheels for precision grinding. This statement is not made at random, but from experience gained from traveling in one of our great manufacturing belts—the Middle West.

Abrasives for Grinding

Before considering the selection of grinding wheels, it may be well to touch briefly on the materials from which they are made. Abrasives are divided into two general classes, namely, natural and artificial. The natural abrasives are emery and corundum. Emery is the oldest known abrasive; it was called smyris by the Greeks, from which its German name schmirgel is taken. The best grade of emery comes from the island of Naxos. It is sold under the name of Naxos emery and is distinguished by its reddish-brown color. A good grade of emery is found in Asia Minor. It is black in color and is known to the trade as Turkish emery. Emery is also found in our own country, principally in Massachusetts and New York. While emery will always have a commercial value for some purposes, its use as a material for precision grinding wheels is limited, owing to the fact that the very best emery is impregnated with a high percentage of oxide of iron. As this impurity cannot be eliminated, wheels made of emery cut slowly when compared with the modern artificial abrasives. We must not lose sight of the fact, however, that emery owing to the impurity previously mentioned, gives a very high finish. For this reason, emery wheels are still used to a certain extent on such work as jig bushings or other tool parts where a "dead smooth" finish is required without the necessity of over-lapping to remove the wheel marks. On commercial work where only a commercial finish is necessary, the emery wheel has almost entirely been replaced by the faster cutting artificial abrasives.

Before the advent of the artificial abrasives corundum was the best abrasive to be obtained. Corundum might be called a high-class emery, for like emery its chief constituent is alumina. However, corundum differs from emery in two important respects: It contains a higher proportion of alumina, and under the pressure of grinding its grains split with a clean sharp fracture, thus presenting a new cutting surface, whereas emery grains simply smooth down and present a highly glazed surface. The best and purest corundum is found in Canada, while an inferior quality is found in this country. Much of the so-called corundum is often highly impregnated with oxide of iron. When this condition exists, its value as an abrasive is little or no better than emery. It cannot be denied that pure corundum makes a fast-cutting wheel for some purposes, but owing chiefly to the prohibitive cost of the raw material, corundum wheels are not commonly sold in competition with wheels made of artificial abrasives.

The artificial abrasives are also divided into two classes, *i. e.*, those made in furnaces of the resistance type, which are called carbide of silicon abrasives, and those made in arc furnaces called aluminous abrasives. In this country, carbide of silicon is made by the Carborundum Co. and sold under the name "carborundum." It is also made in Canada by the Norton Co. and sold under the name of "crystolon." It is also made in Germany and Austria, being marketed under various trade names. These abrasives are all made from materials high in carbon and silica. Under the intense heat caused by the resistance to the passage of the current, a chemical change takes place wherein the elements of carbon and silicon unite, forming carbide of silicon. The best known aluminous abrasives are "alundum," "aloxite" and "boro carbone." These are made from bauxite, a form of clay containing a high percentage of oxide of alumina. The furnace used for this purpose consists principally of a receptacle which contains a quantity of the raw material, and two carbon electrodes between which the current arcs, causing an intense heat. As the mass melts it circulates, thus bringing all of the material into direct contact with the arc. Practically all of the constituents of the crude material with the exception of alumina, are eliminated and pass off in the form of gas, thus leaving practically pure alumina.

Bonds for Grinding Wheels and Manufacturing Processes

After securing an unlimited supply of a good abrasive, it is necessary for the wheel manufacturer to use extreme care in the selection of the material to bind the grains of abrasive into the form of a grinding wheel. There are three bonding methods in common use, *i. e.*, vitrified, silicate and elastic. For the majority of grinding operations, the vitrified bond is considered the most practical. In this process, the bonding material consists chiefly of a pure grade of kaolin. The correct proportions of bonding material and abrasive are mixed wet by what is known as the puddled process, the mass being agitated for a number of hours in mechanical mixers. This mass, which has the consistency of the mud pies of our childhood, is drawn off into molds and dried by steam heat. It is then shaved into shape on a machine not unlike a potter's wheel. The wheel, which is now technically termed "green," is placed in a receptacle made of fireclay called a sagger. The saggers are loaded into a kiln, similar to a pottery kiln, where the process of vitrification takes place. The process of "burning the kilns," as it is called by wheel makers, has everything to do with obtaining correctly graded and sound wheels. The heat has to be watched carefully and kept at known temperatures for definite lengths of time. If the process were hurried, it is probable that 75 per cent of the wheels would come out cracked. The time and attention required to make wheels by the vitrified process is one reason why the grinding department cannot get special wheels a few days after the requisition is sent to the purchasing department.

In the silicate process, the abrasive grain is mixed with silicate of soda and then tamped in a mold by hand. As only a slight heat is required in this case, silicate wheels can often be turned out in a day. Silicate wheels are sometimes used for cylindrical grinding, but not often. For the mechanical grinding of tools on machines of the Sellers type, and for wet grinding of tools by hand, this bond generally gives better results than can be secured with the vitrified bond. In the elastic process, the bonding material is ordinary orange shellac. This material, in a powdered state, is mixed with the correct percentage of abrasive and then baked slightly while under pressure in a hot mold. A second baking in an oven completes the process. The heat causes the shellac to melt, thus firmly binding the wheel together. Shellac wheels are very durable, and for this reason thin wheels, both straight and dished, are often made by this process. These wheels give good results in cutter grinding, as they leave a smooth-edged tooth. For the grinding of the large calender rolls used in paper mills, these wheels give excellent results, leaving the much desired "mirror finish."

Grain and Grade of Grinding Wheels

When speaking of a grinding wheel, "grit or grain" as it

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is often called, means the same as the number applied to emery cloth or bulk emery. Thus, a fifty-grit wheel is composed of particles of abrasive that have passed through a screen having fifty lines or meshes to the inch. Grits vary from 4 (coarse) to 225 (fine) and after the numbers, there are the powders designated by the letters *F*, *FF* and *FFF*. The grits commonly used for precision grinding vary from 24 to 60. There are two kinds of grits, *i. e.*, straight and combination. In a straight grit, all the particles of abrasive are of the same size. In a combination grit, the particles are of different sizes. To determine the sizes and proportions for successful combination grits requires expensive experimenting on the part of the wheel manufacturer. For this reason the well known wheel manufacturers keep their grit combinations as secret as possible. A correct combination grit cuts fast and leaves a good finish at the same time, and generally will remain in a cutting condition for a longer period than a straight grit.

Grade means the degree of hardness of the wheel. The particles of abrasive break away very rapidly from the bond in a soft grade, whereas in a hard grade they are retained longer. As the first grinding wheels (or emery wheels as they were called in the early days of the industry) were for practically one purpose—tool grinding—but few grades were called for. As the industry grew and the scope of the grinding wheel broadened, it became necessary to make a wider range of grades to suit different classes of work. The majority of wheel manufacturers who supply wheels for cylindrical grinding use letters to designate different grades.

Selection of Grade—Effect of Wheel Speed

Under actual working conditions the wheel should be of the correct grade to allow the particles of dulled abrasive to fracture, or wholly break away from the bonding material as soon as they are dulled from wear. While the abrasive cuts the metal away in minute shavings, the work also has a wearing action on the abrasive. Now if the grade is too soft, the particles of abrasive material will break away from the bond before doing their share of the work, which causes the wheel to be short-lived. On the other hand, if the grade is too hard, the particles will not break away from the bond when they become dull, thus causing the wheel to cut slowly and with excessive heat.

The peripheral speed of the wheel has everything to do with determining the correct grade for a certain class of work. High speeds call for softer wheels than low speeds. Thus a wheel of a certain grade might give satisfaction for the grinding of thirty point carbon steel, when run at a peripheral speed of 6000 feet per minute. As the wheel wears away, however, it will gradually appear too soft if the peripheral speed is not increased. For example, after a 20-inch wheel has worn to a diameter of say 19 inches, it will not give as high efficiency as when new because it is under speeded. This condition causes the grains of abrasive to break away from the bond before they should, and the finish left is not so smooth. It is to be regretted that all grinding machines are not driven by variable speed motors. If this were the case, and the operator was provided with an instrument for determining at a glance the surface speed of the wheel, a vast amount of time and trouble could be eliminated. As grinding is at present only in its infancy, or at best in its early childhood, these improvements may come in time.

At the present time, however, the grinding department has to get along without refinements of this kind. Take as an example the wheel just referred to, assuming that it were used for grinding machinery steel. When the wheel was new, the finish left was satisfactory and the wheel stood up well. After it had worn to a diameter of 19 inches, the operator noticed that the finish was not so good and that the wheel seemed to wear more rapidly than it did at first. Perhaps he increased the speed; and if so, what was the result? The wheel seemed too hard under the new operating conditions and glazed readily. The wheel was now over-speeded because the steps on the driving cone were not designed to give correct speeds at all diameters. The preceding may seem trivial in itself, but this one factor has caused more grinding troubles than all others put together. There is, however, a makeshift method of overcoming this difficulty that will be explained later.

Now along comes the grinding wheel salesman from a concern in competition with the one that furnished the wheel that appears unsatisfactory. His head is full of theory and his note-book full of data. When he learns that his competitor's wheels are not giving satisfaction, he takes a nice long inward smile, looks extremely wise and asks innumerable questions about operating conditions, after which he generally winds up by getting permission to submit several of his wheels on approval. He may improve conditions and again he may not. It all depends on whether he is a real expert who thoroughly understands cylindrical grinding conditions, or simply what is termed a clever salesman who is willing to take a pot shot at any condition or circumstance that may bring him future business.

Now a dozen trial wheels may not remedy the difficulty referred to, because the fault is not with the wheel but with the conditions under which it is run. In a case of this kind, the wheel should be dressed with a dull diamond, using a fine feed. This will give it a cutting surface not unlike a slightly glazed wheel. Under these conditions the grains will not break away from the bond so readily, and the finish will be the same as when the wheel was used under normal conditions and up to speed. After the wheel has worn to a diameter of say 18 inches, it can be speeded up again and trued in the regular way with a sharp diamond. The condition of the diamond has much to do with the finish left by the wheel. As a matter of experiment, take a wheel that is running at the proper speed, and that has been trued with a sharp diamond. It is giving a good finish and cutting fast. Now dress the same wheel with a dull diamond and it will be found to cut slowly and glaze readily. For this reason many operators use a sharp diamond to dress wheels that are running at correct speeds, reserving a dull diamond for wheels that are found to be too soft between changes of speed. It is, of course, a good plan to test wheels of different makes occasionally; otherwise, one is likely to fall into a rut and become behind the times.

Factors Affecting the Grain and Grade—Work Speed

In ordering wheels for test purposes, either direct or from the salesman, it is necessary to give the following authentic information: Surface speed of wheel; finish desired, rough, commercial, or fine; material to be ground; diameter of wheel; width of wheel; size of hole; and diameter and depth of recesses, if any. The foregoing specifications may appear meager to one who has seen the order blanks carried by many grinding wheel salesmen, with the columns for data concerning depth of cuts, traverse feeds, work speeds, etc. The writer does not hesitate to state that this information is of absolutely no value in selecting the grit and grade for a certain class of grinding. These details are insisted upon by some wheel manufacturers, it is true, but scientific research or practical experimenting has yet to prove that depth of cut, work speed or traverse feed are important factors in the selection of grits and grades. As far as grit and grade are concerned, it does not matter whether 0.010 inch or 0.100 inch is to be removed. To be sure, a coarse wheel in a straight grit will grind faster than a coarse wheel in a combination grit; also a soft wheel will cut faster than a hard one. Thus it is seen that the finish desired really determines the grit and grade. For example, suppose that a wheel was ordered for roughing out machine steel, a fast cutting wheel being wanted and finish being of no consequence. This would call for a coarse straight grit wheel, in a soft enough grade to allow the grains of abrasive to break away before becoming dulled. A 24 straight grit of suitable grade is often specified for this class of work. If the work were both roughing and finishing, only a commercial finish being desired, a wheel in 24 combination grit of the proper grade would probably be selected. If, on the other hand, a very fine finish were desired, the wheel could be as fine as 60 grit.

On the subject of work speed, authorities of recognized ability differ. The Norton Co. recommends slow work speeds for finishing cuts when coarse combination grit wheels are used. On the other hand, the Landis Tool Co. advocates high

work speeds for finishing. The following is taken from the Landis "Grinding Data and Tables." "For rough-grinding steel, traverse nearly the full width of the wheel for each revolution of the work. This will cause the wheel to wear more uniformly and require less truing, but when a fine finish is desired, a faster work speed with a slower traverse is required."

As a matter of fact, we can vary the work speed from 10 to 50 feet per minute surface speed or even reverse the direction of motion (that is, have the wheel and work revolving in opposite directions) and get good results. The traverse feed of the work is always determined by the work speed and the width of the wheel. The wider the wheel, the faster the traverse feed. This is readily understood, as the work can be traversed very nearly the width of the wheel for each revolution. Thus when the work speed is increased, the traverse feed can be finer, and still be practically the same number of linear feet per minute. Slow work speeds are necessary while taking heavy roughing cuts; otherwise, unnecessary frictional heat is developed. Thus it is seen that depth of cut, work speed and traverse feed are not important factors in the selection of grits and grades for different classes of work, as these factors are readily regulated to suit the wheel. While three points only are generally considered in the selection of wheels, namely, surface speed, finish desired and material to be ground, there are eight factors that determine efficient results. They are the ones just named, together with grit, grade, depth of cut, work speed and traverse feed. The grit and grade is determined by the material to be ground and the finish desired. The surface speed of the wheel also has to be considered when selecting the proper wheel, as a comparatively soft wheel always calls for a higher peripheral speed than a medium grade wheel. The other points, depth of cut, work speed and traverse feed, can always be adjusted to conform to the wheel and local conditions.

Trial wheels should be tested by competent operators and, when possible, under the direct supervision of the grinding room foreman. The following points should be carefully considered:

(1) Is the wheel being used on the class of work that it was ordered for? (2) Is it being run at the correct peripheral speed? (3) Does it leave the required finish? (4) Is it too hard, requiring frequent dressing? (5) Is it too soft, wearing away too rapidly? (6) Does it cut faster than the wheels previously used; that is, will it turn out more work per day? All these details should be considered before forming a decision, for if it is worth while to order wheels for test purposes, it certainly is worth while to form a correct opinion of the results attained. In other words the operator's, "I think this is a pretty good wheel" should not be considered sufficient. The sixth question should be given careful consideration, for it is the earning power of a wheel that determines its efficiency. In cases where wheels are used on routine work, a satisfactory method of testing is as follows:

(1) Weigh the wheel. (2) Note its cost. (3) Use the wheel for a week on one kind of work. (4) Note the number of pieces ground. (5) Note the labor cost. (6) Weigh the wheel again. As an example, suppose we are testing a 24-inch by 2-inch wheel. This weighs approximately 70 pounds and costs 18.8 cents per pound, as the cost of the wheel is $13.18. We use this wheel a week, and in this time grind say 1000 pieces, at a labor cost of $20. The wheel wears to a diameter of 18 inches, then weighing 45 pounds. From this we have the following:

25 pounds of wheel at 18.8 cents per pound	$4.70
One week's labor	20.00
Total	$24.70
Cost per piece for grinding	2.47 cents

In a test of this kind we have authentic data to prove whether or not one wheel is more efficient than another.

Some grinding wheel manufacturers lay great stress on their service department, aiming to appeal to concerns who have not enough routine work to conduct accurate tests. The title "service department" would suggest to the uninitiated an elaborate array of modern grinding machinery for the testing of various kinds of materials and varieties of work, with the object of securing authentic data as to what wheels should be recommended for certain kinds of work. These conditions, however, are generally as far from actual facts as dreams are from realities. A service department generally consists of one man having a thorough knowledge of wheels, not only of his own concern's but of his several competitors' as well. He has on file for ready reference data concerning successful wheels for practically every known grinding operation. This, together with the information sent with the salesman's order, guides him in his decisions. He is guided principally by the three factors: surface speed of wheel, finish desired, and material to be ground. In due justice to him we must admit that he generally makes very accurate decisions. When he fails, he relies on the salesman to furnish him with data as to why the wheel was not successful. With this information he forms a new decision, changing the grit and grade, and in some instances the bond to overcome the previous failure.

Some grinding wheel manufacturers employ demonstrators who are experts at grinding. Now a demonstrator may come to any shop and show remarkable results because he works at high tension to have his wheels make good. It does not follow, however, that the operator who does the actual work, day after day, can get the same results, and as a matter of fact he seldom does. Grinding wheel demonstrators are like grinding wheel salesmen in that they have plenty of arguments to offset the other fellow's. Any demonstrator can cite numerous instances where his wheels have made good, but he keeps very quiet regarding cases where one of his competitor's won out over him. These are reasons why it is always a good plan for the manufacturer to work out his own grinding problems in his own shop with his own men, ever bearing in mind the fact that the crucial test should result in a few cold hard figures that have been obtained through common sense experimenting under actual working conditions.

* * *

POLISHING ALUMINUM CASTINGS

The following directions for polishing aluminum castings are given in the *Foundry*: When polishing aluminum it is advisable to avoid the use of coarse abrasives if possible, as they drag or pull the metal and render the surface difficult to finish. If, however, the castings are quite rough, first polish with No. 70 emery, then grease on No. 120 emery with a compressed canvas wheel, and follow with No. 160 emery on a felt wheel; then impart the final luster by buffing, using a good grade of white polish on a stitched cotton wheel. If the castings are not rough the treatment with No. 70 emery may be dispensed with and the castings finished on No. 120, followed by No. 160 emery, and buffed.

If the castings are of simple pattern, the polishing may be accomplished almost entirely by tumbling. If rough, use coarse sand or crushed granite to produce a uniform surface; this treatment may appear too harsh, but owing to the peculiar nature of the metal it requires a sharp abrasive for roughing in a tumbler. The sand or granite is used wet, about the consistency of thin mortar. When sufficiently roughed, the castings are washed and transferred to a wooden or wood-lined tumbling barrel and tumbled with steel balls or smooth steel punchings in water containing ¼ ounce oxalic acid to the gallon. This treatment requires from two hours to two days, depending on the shape and condition of the castings and the speed of the barrel, the proper speed being just sufficient to cause the load to roll and not to jump across the barrel. When properly tumbled in this manner and finished on a buff wheel as previously stated, the finish is equal to and in many cases superior to a wheel polish, and the cost of production is decidedly less, as many hundreds of pieces can be treated at one time. But little labor is required and a boy can soon be taught to load and unload the tumblers. Naturally, if the utensils are large and thin, or hollow, the wheel treatment must be employed.

Entered at the Post-Office in New York City as Second-Class Mail Matter

MACHINERY

DESIGN—CONSTRUCTION—OPERATION

PUBLISHED MONTHLY BY

THE INDUSTRIAL PRESS

140-148 LAFAYETTE STREET, NEW YORK CITY

51-52, CHANCERY LANE, LONDON, ENGLAND

Cable address, Machinery New York

Alexander Luchars, President and Treasurer
Matthew J. O'Neill, General Manager
Robert B. Luchars, Secretary
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Erik Oberg, Franklin D. Jones, Douglas T. Hamilton,
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Associate Editors

Yearly subscription—$2.00; coated paper, $2.50; Foreign edition, $3.00. The receipt of a subscription is acknowledged by sending the current number. Checks and money orders should be made to THE INDUSTRIAL PRESS. Money enclosed in letters is at the risk of the sender. Changes of address must reach us by the 15th to take effect on the following month; give old address as well as new. Single copies can be obtained through any newsdealer.

We solicit contributions from practical men on subjects pertaining to machine shop practice and machine design. All contributed matter published exclusively in MACHINERY is paid for at our regular space rates unless other terms are agreed on.

OCTOBER, 1914

NET CIRCULATION FOR SEPTEMBER, 1914, 25,311 COPIES

COST DATA URGENTLY NEEDED

There is a great scarcity of technical literature relating to manufacturing costs, and few indeed are the articles published that give the actual figures for producing the component parts of a machine. This is a lamentable weakness of technical publicity for which the conservatism of manufacturers, and not the lack of enterprise of editors, must be held accountable. Yet there is no subject of greater importance to the average designer, contractor and builder than that of costs; for without a thorough knowledge of that subject he cannot safely undertake to design and build machinery in competition with other concerns.

There must be considerable data of that kind which could be made public without injury to the manufacturers concerned, covering the cost of building machinery, and starting from the drafting-room. It is especially desirable that all items should be given, including designing, drafting, pattern-making, foundry work, machining, selling, shipping, overhead and profit. The salaries and wages of officials, superintendents, foremen, designers and draftsmen, machinists and salesmen would be of great value; also the approximate location of the plant, shipping facilities, costs of coal, pig iron, structural iron and other materials required. The name of the manufacturer need not be given.

* * *

SPECIALIZING IN TECHNICAL WRITING

Many contributors to technical journals make the mistake of trying to cover too many subjects at once, and are therefore unable to cover any one thoroughly. Some apparently believe that the editor prefers long and discursive contributions to short and concise ones, which is an erroneous idea. A short article which covers a single subject completely is in most cases far more worthy of publication than a long treatise containing a great deal of matter which is merely incidental and desultory. Some writers—and very good ones at that—have the habit of saying that a certain subject will require more space than can be given to it, and it is therefore not treated at all. This is a mistake. If so little is known on the subject that it requires extended explanation, covering a great deal of space, it is ten to one that such use of the space would be justified. But if the subject is so unimportant that it is not worthy of extended space it is very likely it could be disposed of with a few general remarks, making unnecessary any reference to the space it will take.

The editor often entertains a strong suspicion that the real reason why a writer does not use up space to discuss a certain subject is because he is not sure of his facts and makes a statement of this kind in order to cover up his own shortcomings. As one of the most valuable results from writing for technical journals is the self-instruction the writer himself receives, it would be worth while for any writer who finds himself using the old evasion, "This would be too lengthy to treat in detail here" to set himself the task of obtaining all the information available on the subject, and then writing an article to cover it completely and concisely. In this way he would inform himself thoroughly on the subject and would handle it with that ease which only definite knowledge and perfect confidence give.

* * *

HOBBING RATCHETS AND SPLINED SHAFTS

The gear hobbing process is by no means confined to the cutting of spur, spiral and worm gear teeth. Hobs are usually made to generate symmetrical teeth, but they may be also designed to generate other forms as well. Ratchet teeth of various shapes, including radial faces and straight backs, can be hobbed rapidly, the product being equal in every respect to teeth cut by the usual indexing method. The study of forms that can be produced by the hobbing generating process is fascinating, and some surprising results are likely to come from the investigations now being made by specialists in this old-new art.

The hobbing of four-, six- and eight-spline shafts for automobile gear boxes is a comparatively recent development that is likely to become an important feature of manufacturing practice. Square shafts for sliding gears are being replaced by splined shafts having the splines integral with the shaft. To produce them by planing or shaping machines is a slow and costly process, requiring the attention of skilled workmen. The hobbing process is rapid and practically automatic in action. The splines can be made with square corners and straight sides, or with rounded corners and fillets and sloping sides. Broaching is the only alternative method.

The hobbing of wheels with square teeth and tooth spaces is readily accomplished, making possible the production of certain types of wheels used in adding machines, counters, etc. The cost of production is reduced to so low a figure that it seems almost absurd to attempt to still further cheapen it, as it has been lowered to a point that is practically negligible when compared to the retail prices of the machines in which they are used, but the manufacturer must never stop in the pursuit of more efficient methods. To do so means stagnation, and stagnation is industrial death.

* * *

THEORY AND PRACTICE IN MACHINE DESIGN

The beginner or the man untrained in designing has often the view that theory has a formula to fit every case which may arise in practice. While his reason for this view differs, the assumption is in its effects the same as that of the occasional man of science whose relation to the mysteries of the universe is summed up in the arrogant creed that everything to which he applies it must yield to his power of analysis. The words of the dying Lord Kelvin—who knew more of the material universe than any man since Sir Isaac Newton's day—tell a different story. "So much to do; so little done," he said, after a lifetime of unceasing mental toil. He knew that even his superb reasoning faculties were relatively slow and inefficient for the many tasks before them; that they could work only with effects, never with the first causes which must lie always hidden behind time's veil; and that his only knowledge of those effects must reach his brain through the medium of a group of very imperfect senses. With such limitations, the wonder is, not that the designer fails in his theoretical analysis of some difficult cases and must seek the aid of empirical data derived from practice, but that he has done so well in pointing the way to the correct solution of so many complex problems of strain and stress.

The history of machinery gives many instances of the intricate calculations which the demands of progress have forced upon the mathematician and designer. For example, take some of the many problems of inertia and vibration. Rankine by his early study and Dunkerley by his later analysis have made it possible to predict and provide for "whirling," that violent and dangerous whipping action of mill shafting which occurs at one—and only one—critical speed, when there is coincidence between the natural period of vibration of the shaft and that of its vibration as, in revolving, it sags between its bearings. Similarly, Normand, Dalby and Schlick, through their years of investigation, have enabled the designer so to distribute the weights of the rotating and reciprocating masses of a machine as to eliminate unbalanced moments and absolutely prevent vibration. Finally, the more recent experiments of Frahm and others have shown that it is unsafe to design large shafts for only the power to be transmitted, since besides the natural torsional vibration, there is usually an added synchronous vibration with a corresponding increase in torsional stress.

These, however, are questions of pure theory. Let us glance briefly at the practical side of designing. For example, in a flywheel, it is possible for the designer to calculate with reasonable accuracy the stress produced in the rim by centrifugal force; but for the actual effect of the arms of the wheel in modifying this stress, he must rely on the bursting tests of practice. Again, in designing the rod for a large slide valve, he can readily figure the normal inertia stresses, the maximum unbalanced load on the valve, and assuming some conventional coefficient of friction, the corresponding force which will resist the valve's motion; but a rod designed for these stresses only would be far too weak. The engine may be started suddenly and carelessly, making the valve's resistance a suddenly applied load of twice its static effect, or scale, core-sand, or rust due to a long idle engine may make his assumed coefficient absurd. For these reasons an empirical constant must be introduced in the calculations.

Instances like these abound throughout the whole range of designing; they are the rule, not the exception. The function of pure theory is hence simply to point the way, to blaze the path through the jungle of the unknown for the broad road of progress which practice, following in its steps, must build; and occasionally, too, theory wanders far afield, only to receive in due time from practice and experience a rude jolt backward to the right course. For the beginner in designing there can therefore be no safer guide than that old saying, prehistoric in its wisdom: "It is better to know a few things well than so many that are not so."

* * *

COURTESY PAYS

A traveling salesman of a well-known machine tool builder, although a philosopher, sometimes yields to the impulse to write to the editor about his troubles, and the following is reproduced for the benefit of those who regard such visitors as intruders, to be treated discourteously on general principles:

> Why do so many proprietors of machine shops seem to think that a machinery salesman is a natural enemy of the machine shop proprietor? At one place where I recently called I got "two orders," one to get out and the other to stay out. At a neighboring place I didn't get an order, but was politely received and conducted through the shop. I found the product of that shop was such that their claim that they had no use for the kind of machinery I was trying to sell was well founded. At the same time I learned that they were making something that I had no idea was being made in that section, and they seemed to be making it well. I will pass that word along. I had been told at the place where I got the "two orders" that they made special machinery to order, but on account of the "two orders" I don't really know anything about it. Hardly a day passes that I am not asked where this or that can be obtained. "Where can I get a tool-maker, where can I get a draftsman, and also where can I get a special machine built?" There is a moral.

This is the view of a salesman—in this case an unusually intelligent salesman. If the manufacturer's view were given it would probably be to the effect that only a small percentage of the salesmen who call are able to give any information of value to a manufacturer, except about the line of goods they are selling; and sometimes not about that. Whichever view is correct, there can be no question that courtesy to every caller is a good investment, if for no other reason than that you make a friend instead of an enemy.

* * *

CONVENIENT FORMS OF LEWIS FORMULA FOR STRENGTH OF GEAR TEETH*

BY J. H. CARVER†

When figuring the strength of gear teeth, the terms usually under consideration are horsepower, diametral pitch, number of teeth and width of gear face. In Kent's Handbook are found the two following forms of the Lewis formula for strength of cast-iron and steel cut gear teeth:

$$\text{H. P.} = 0.0000079\, dspfy \times \text{R. P. M.} \qquad (1)$$

$$W = spfy \qquad (2)$$

where H. P. = horsepower transmitted;
d = pitch diameter of gear in inches;
s = unit stress, depending on peripheral speed at pitch line;
p = circular pitch;
f = width of face in inches;
y = a constant relating to the 14½-degree involute tooth and depending on number of teeth;
R. P. M. = revolutions of gear per minute;
W = load transmitted by teeth in pounds.

TABLE I. VALUES OF THE FACTOR OF STRENGTH y FOR 14½-DEGREE INVOLUTE AND CYCLOIDAL TEETH

No. of Teeth	y	No. of Teeth	y	No. of Teeth	y
12	0.067	20	0.090	43	0.110
13	0.070	21	0.092	50	0.112
14	0.072	23	0.094	60	0.114
15	0.075	25	0.097	75	0.116
16	0.077	27	0.100	100	0.118
17	0.080	30	0.102	150	0.120
18	0.083	34	0.104	300	0.122
19	0.087	38	0.107	Rack	0.124

Machinery

Formula (1) transformed to one where the terms most generally known are used becomes:

$$\text{H P.} = \frac{0.000095\, Vsfy}{P} \qquad (3)$$

Treating Formula (2) in the same way, we have:

$$W = \frac{s\pi fy}{P} \qquad (4)$$

where V = velocity in feet per minute at pitch line;
P = diametral pitch.

Formulas (3) and (4) are obtained by substituting in Formulas (1) and (2) the following values:

$$V = \frac{\pi d \times \text{R. P. M.}}{12} \text{ or } d = \frac{12V}{\pi \times \text{R. P. M.}}$$

$$p = \frac{\pi}{P}$$

$$\text{H. P.} = 0.0000079 \times \frac{12V}{\pi \times \text{R. P. M.}} \times s \times \frac{\pi}{P} \times f$$

$$\times\, y \times \text{R. P. M.} = \frac{0.000095\, Vsfy}{P} \qquad (3)$$

$$W = spfy = \frac{s\pi fy}{P} \qquad (4)$$

Example 1: What horsepower will a 30-tooth, 5-pitch, 3-inch face cast-iron gear transmit running at 900 revolutions

* For additional information on the strength of gears and allied subjects published in MACHINERY, see also "Tests for the Strength of Gear Teeth," January, 1914; "Logarithmic Chart for Finding the Strength of Gear Teeth," by H. T. Millar, October, 1912; Charts for Horsepower Transmitted by Gearing and Belting," by C. E. Evans, August, 1912; "Strength of Gear Teeth—Derivation of the Lewis Formula," September, 1911; "Strength of Helical Gears," October, 1908; "Variation of the Strength of Gear Teeth with their Velocity," by Ralph E. Flanders, January, 1908; and "Strength of Gears," by John S. Myers, December, 1906.

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per minute? A 30-tooth, 5-pitch gear has a pitch diameter of 6 inches.

$$V = \frac{\pi \times \text{pitch diameter}}{12} (\text{R. P. M.}) = 0.26 \times 6 \times 900 =$$

1404 feet per minute at pitch line.

$s =$ say 2270 (from Table II)

$y = 0.102$

$P = 5$

TABLE II. SAFE WORKING STRESS s FOR VARIOUS SPEEDS

Speed at pitch line in feet per minute	100 or less	200	300	600	900	1200	1800	2400
Cast Iron........	8000	6000	4800	4000	3000	2400	2000	1700
Steel............	20,000	15,000	12,000	10,000	7500	6000	5000	4800

Machinery

$$\text{Therefore H. P.} = \frac{0.000095 \times 1404 \times 2270 \times 3 \times 0.102}{5} = 18.5.$$

Load safely transmitted by this gear is:

$$W = \frac{\pi s f y}{P} = \frac{\pi \times 2270 \times 3 \times 0.102}{5} = 436 \text{ pounds.}$$

TABLE III. SUITABLE PITCHES FOR GEARS TRANSMITTING VARIOUS HORSEPOWERS

Horsepower Transmitted	Pitch	Horsepower Transmitted	Pitch	Horsepower Transmitted	Pitch
1/8	12	3	6	25	3
1/4	10	5	6	50	2½
1/2	10	7½	5	60	2½
3/4	10	10	4	75	2
1	8	15	3	100	2
2	8	20	3	150	1½

Machinery

Table III shows suitable pitches for various horsepowers. Using a smaller sized tooth, of course, means a wider face for a given horsepower and a narrower face for a larger tooth; but in general the pitches given are satisfactory regarding proportion of face to diametral pitch.

Example 2: An 18-tooth cast-iron gear is needed to transmit a maximum of 20 horsepower at 600 revolutions per minute. What pitch and face width should be used? From Table III we find that 3 diametral pitch is suitable, which means the use of a gear of 6 inches pitch diameter; and running at 600 revolutions per minute, this gives a speed of $0.26 \times 6 \times 600 = 936$ feet per minute at the pitch line.

From Equation (3) we have:

$$f = \frac{P \times \text{H. P.}}{0.000095\, Vsy}$$

$s = 3000$

$y = 0.083$

$$f = \frac{3 \times 20}{0.000095 \times 936 \times 3000 \times 0.083} = 2.7 \text{ inches, say}$$

2¾ inches face.

* * *

Attention is called in the *Travelers' Standard* to the danger of the bursting of a grinding wheel used for internal grinding. An internal wheel is most likely to burst when it is first withdrawn from the hole. It becomes heated while in use and the air inside of the hole where the grinding is done is likely to be quite warm. When the wheel is then quickly withdrawn and exposed to the cool air outside of the work, the chill that it receives gives rise to severe contraction stresses which sometimes cause the wheel to fly apart violently.

* * *

It is stated that all of the 15-inch guns for the five British battleships of the Queen Elizabeth type were ordered without a trial gun being made and tested. When they were tried, the results agreed exactly with the calculations of the designers. The new guns are said to be the most accurate at all ranges yet built for the British navy. The explosive charge is 50 per cent greater than for the 13½-inch guns previously used on the super-dreadnaught type of battleships.

CUTTING METALS WITH TOOTHLESS DISKS

Technical literature of the past contains the records of many inventions generally considered modern, and the cutting of metals by toothless disks has formed the subject of numerous re-inventions. Though a certain German firm now claims to hold master patents in this field, the principle of cutting hot or cold metals by a rapidly rotating disk of relatively soft metal was known and applied at such an early date that, as pointed out by Prof. Codron in *La Machine Moderne*, machine tool designers are at liberty to evolve freely special types of "toothless saws." In 1880, Reese of Pittsburg discovered that a rapidly rotating soft iron disk would cut cold steel, but references to the same process are to be found in writings dated very early in the nineteenth century. Reese held the view that the soft disk did not actually touch the bar cut, but compressed and heated intensely the air between disk and bar, so that cutting was due to violent projection of hot air particles onto the steel or other metal severed. This and other hypotheses were much discussed in the early eighties, but it was soon admitted generally that cutting was due to melting by heat generated by friction between the soft disk and the bar cut.

Toothless cutting disks absorb considerable power while in service, but the rapidity with which they work and the excellence and importance of the results obtained make the total cost of energy relatively negligible. For example, the cost of cutting a bar 4 inches by 0.55 inch at 0.12 inch per second by a disk absorbing 15 horsepower is only 0.44 cent if electrical energy is available at 2 cents per unit. Prof. Codron finds that the power ($W =$ watts) absorbed by a toothless cutting disk is expressed by: $W = Ka^m$ where K and m are numerical constants and a is the feed in millimeters per second. The power W_1 required per cubic millimeter of metal removed varies rapidly with the feed, and, to reduce the net and total energy expenditure required, the feed should be as great as possible, particularly since the power required merely to drive a large disk at high speed is considerable. For cold iron, $W_1 = 55.5 \div a^{0.32}$ (the normal pressure between disk and work being 5, 23½, and 50 pounds, respectively, with feeds of 2, 39, and 118 millimeters per second). At a red cherry heat, the power required to cut iron by a toothless disk is: $W_1 = 32.7 \div a^{0.37}$ (roughly half that required for cold cutting), but a toothed saw absorbs only one-eighth as much power ($W_1 = 4.12 \div a^{0.36}$). It follows that toothed saws should be used to cut hot pieces which have not to be heated specially for sawing (*e. g.*, rails leaving rolling mills). In cutting cold pieces of small or medium thickness, toothless disks are more rapid and less expensive than toothed saws, and are now used extensively (often in automatic machines) to cut bolts, high-speed tool blanks and slots in screw heads.

It is easy to adapt existing grinding and milling machines to carry a toothless cutting disk, and circular metal sawing machines may conveniently be fitted also with a toothless cutter. Thin pieces of iron can be cut easily by the back of a wood-cutting band saw running at 50 feet per second, and toothless band saws running from 80 to 120 feet per second, in specially designed machines, can be used advantageously to cut tubes, fretwork, etc. A simple iron wire is useful in special cases, but breakages are frequent, owing to the considerable tension under which the wire must be used. A paper disk, say ¾ inch in thickness, 15 inches in diameter, and running at a peripheral speed of 160 feet per second, will cut its way easily through wooden planks ½ inch or even ¾ inch in thickness. The wood is burnt away at the cut, clean brown ends are left on the pieces, and the wear of the cutting disk is surprisingly small. Though power-driven saws are now used extensively to cut hot metal, one rarely finds hand saws used for this purpose, yet an ordinary carpenter's saw is extremely useful in severing special, fairly light sections of red-hot iron. The saw should be worked quickly to prevent excessive local heating, and should be quenched at intervals during and after use. Though the teeth of the saw lose some of their effectiveness for cutting wood after such treatment, they can be used repeatedly to cut hot iron without sharpening and resetting.

SHAFT TURNING OPERATIONS AT THE POND SHOPS

TOOLS AND METHODS EMPLOYED IN EFFICIENT SHAFT TURNING

BY A. SPANGENBERG*

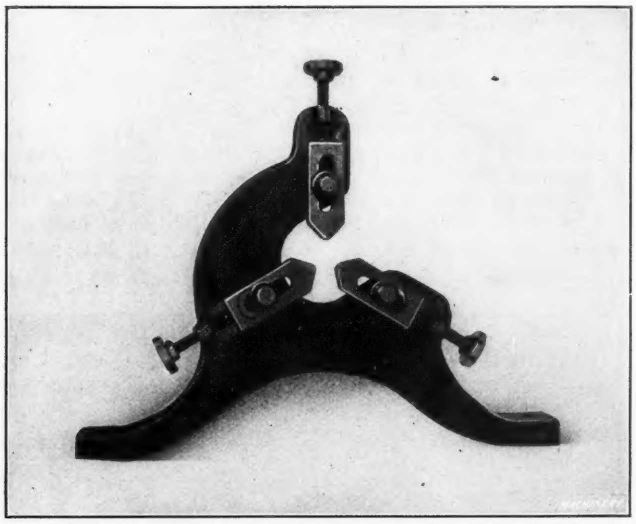

Fig. 1. Commercial Type of Follow-rest which is Unsuitable for Shaft Turning

THE turning of long shafts in an economical and efficient manner may be considered a separate branch of engine lathe work, since it requires special tools and fixtures and special knowledge and skill on the part of the operator. Accuracy, both as regards diameter and straight turning, is essential, and to maintain these standards throughout a shaft 75 feet or more in length without resorting to practically any filing is the principal difficulty involved. Two general methods are described and illustrated in the following article which represent the practice employed at the Pond Works of the Niles-Bement Pond Co., Plainfield, N. J. The first is applicable to turning shafts up to 2 inches in diameter and employs the principle of high cutting speed and light feed, while, inversely, the second method illustrates the idea of turning larger diameters at a comparatively slow cutting speed, using a heavy feed. This is logical, since the diameter in each case and also the length of shaft control to a great extent the permissible speeds and feeds.

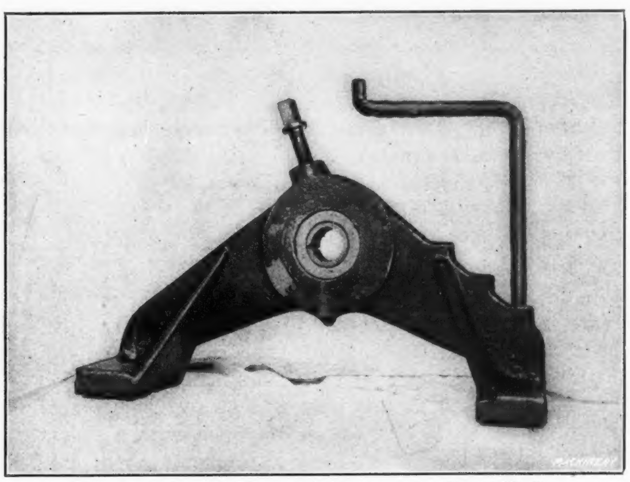

Fig. 2. Improved Form of Follow-rest for Small Shafts

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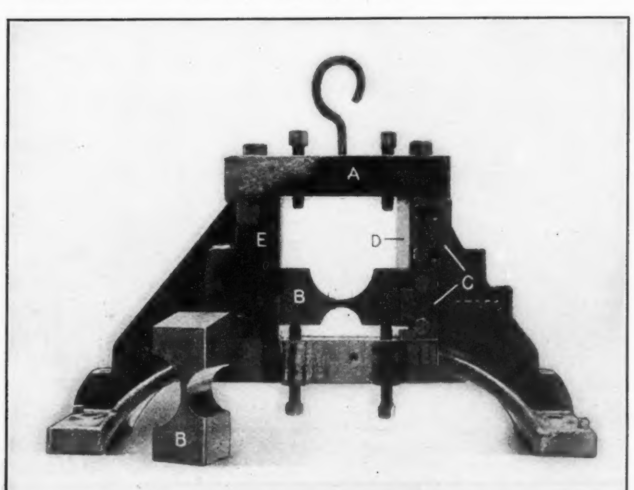

Fig. 3. Follow-rest adapted for Large Shafts

Special Types of Follow-rests and Supports

As the principal factor tending toward accurate and economical shaft turning is the provision of a rigid support for the shaft near the cutting tools, attention is first directed to the various types of follow-rests, which, as the name implies, are rests bolted to the lathe carriage for following the cut and supporting the work. The nearest approach to absolute rigidity in this supporting member is essential, and a study of the commercial type shown in Fig. 1 will at once impress the observer with the fact that it lacks rigidity and durability. Two follow-rests of an improved form are illustrated in Figs. 2 and 3. Fig. 2 shows the type best suited to shafts of small diameter—2 inches and under. After being bolted and doweled to the lathe carriage, this rest is bored concentric with the lathe centers. Cast-iron split bushings of various diameters to suit the work are provided. The idea of the set-screw and split bushing is to take up

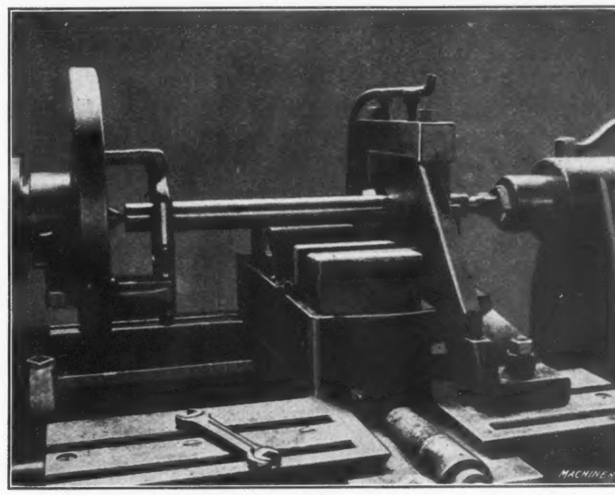

Fig. 4. Method of boring Follow-rest to insure Hole being Concentric with Lathe Centers

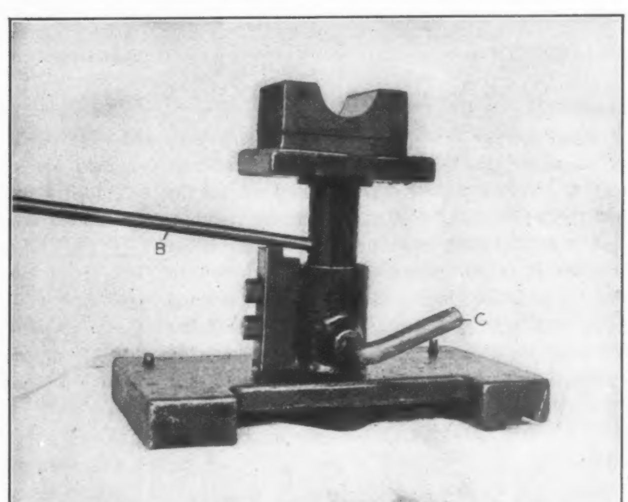

Fig. 5. Support or "Jack" for Long Shafts—used in Place of Regular Center Rests

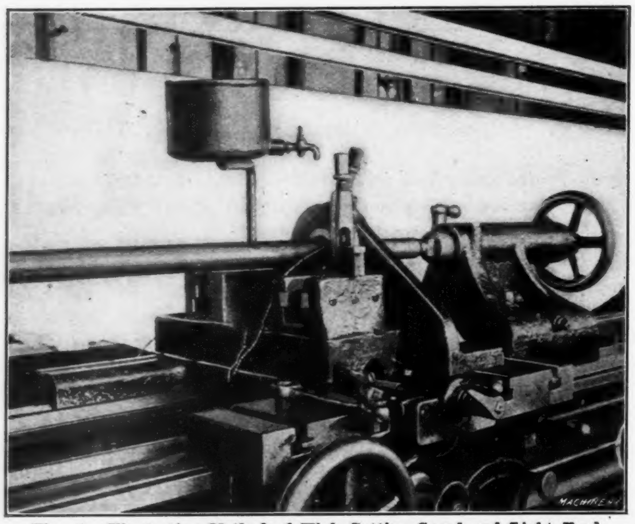

Fig. 6. Illustrating Method of High Cutting Speed and Light Feed

slight wear, and when worn out the bushings are rebored to the next larger size.

The rest shown in Fig. 3 is designed for large shafts, and being provided with a cap *A*, it can easily be put into position on the lathe carriage with a shaft in place without having to slide it on from the end of the shaft. This feature is particularly valuable when the length of the shaft exceeds that of the lathe bed on which it is being turned. The blocks *B* are adjustable for height and are held in position by the

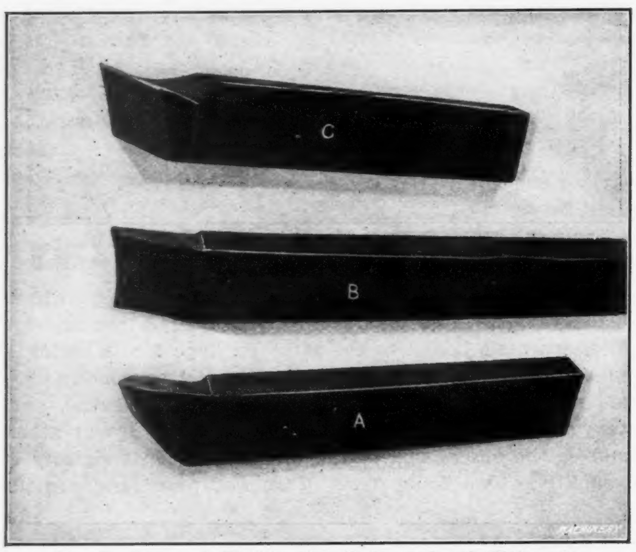

Fig. 7. Types of Shaft-turning Tools—made of High-grade, High-speed Tool Steel

slotted clamps *C*. One of the blocks is removed to show that guiding surface *D* is beveled, while *E* is straight. It will also be observed that one set of blocks serves for two sizes of shafts. Fig. 4 shows the method of boring out follow-rests, and the operation is so simple as to need no explanation.

A most convenient form of support, or jack as it is sometimes called, is shown in Fig. 5. This jack carries a hard-wood block *A*, the height being adjusted to suit the work by means of the bar *B* and clamping screw *C*. A number of these jacks, together with an assortment of various sized wooden blocks, are provided for each shafting lathe.

The High Speed and Light Feed Method

It was previously stated that the diameter and also the length of a shaft control to a great extent the permissible cutting speed and feed. An example of high-speed turning is illustrated in Fig. 6 which shows part of a shaft 2 inches in diameter and 15 feet long. The reduction in this case is 1/16 inch in diameter at 200 feet peripheral speed and 1/32 inch feed. The material is machinery steel. When necessary, on account of several diameters on a shaft of about this diameter and length, it is frequent practice at the Pond Works to make a ¼-inch reduction in diameter at the same speed and feed as just mentioned. As shown in the illustration, but one tool is used and one cut finishes the shaft to size, a final polishing with emery cloth producing a good finish. The tool is a "diamond point" tool with a slightly rounded end. The form of the tool is shown at *A* Fig. 7. The angles to which the three shaft-turning tools shown in this illustration are ground are as follows:

	Clearance	Side Slope	Back Slope
Diamond point tool *A*............	30	7	10
Roughing tool *B*.................	15	5	10
Finishing tool *C*................	20	10	0

In order to convey an idea of the possibilities of high-speed turning, a concrete example is shown at *A* in Fig. 9. The dimensions of the shaft, which is of chrome-nickel steel, are

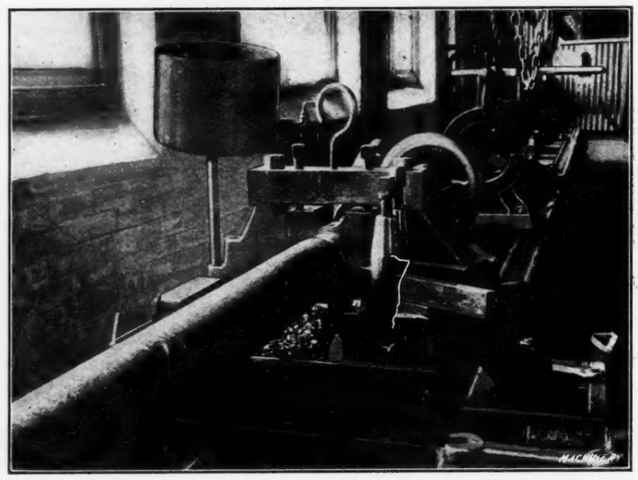

Fig. 8. Roughing and finishing a Large Shaft in One Operation, using Two Tools

indicated in the illustration, and the actual time for turning it all over was 7 minutes.

The Slow Speed and Heavy Feed Method

In turning long shafts over 2 inches in diameter, it has been found advantageous to use a slower speed and a coarse feed, because with a given depth of cut, metal can be removed more quickly than by using a fine feed and a proportionate increase in speed. This method also lends itself readily to the use of two tools simultaneously, one roughing and the other finishing. An example of this kind is illustrated in Fig. 8. The cutting speed in this case was 60 feet per minute on a machine steel shaft 3 inches in diameter, with a reduction of ⅜ inch in diameter and a feed of ¼ inch. About 0.010 inch in diameter was taken by the finishing tool. A better idea of the tool settings is obtained from an inspection of Fig. 10 in which the tools were moved away from the cut and the follow-rest was removed for the purpose of illustration. When setting tools for shaft turning it has been found advisable to set the cutting edges considerably above the lathe centers, as in this way chattering is practically eliminated, and with

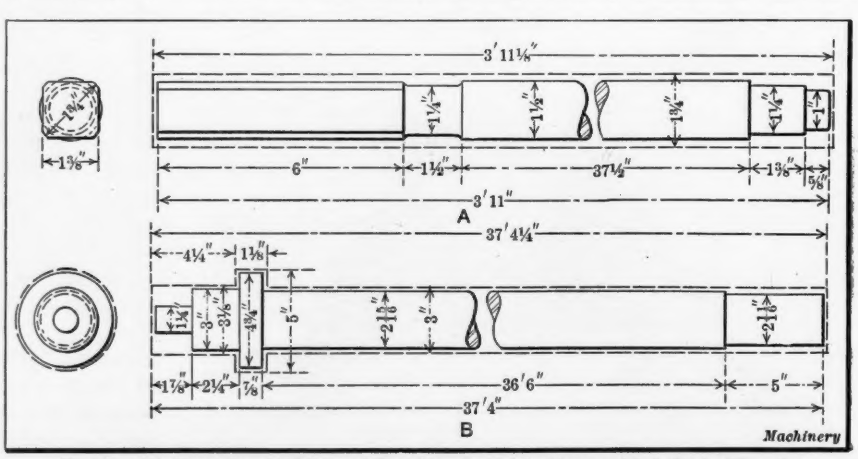

Fig. 9. (A) Example of High-speed Turning; Material, Chrome-nickel Steel; Time for Turning, 7 Minutes. (B) Example of Turning by Slow-speed and Heavy-feed Method; Material, Machine Steel; Time for Turning, 6 Hours

greater clearance angles the tools cut much more freely and consume less power. In the present case, with a 3-inch diameter, the tools shown are set about 1/8 inch above the centers.

The shapes of the tools here used are indicated at *B* and *C* in Fig. 7. The finishing tool *C* is particularly interesting inasmuch as it has an unusually broad cutting edge, 2 inches wide, which is on an angle of 18 degrees with the shank. By using lard oil as a lubricant, and having the cutting edge of the tool slightly rounded, an excellent finish is obtained on the work. Shafts 4 inches in diameter and 96 feet long have been turned at the Pond Works by the methods just described. Another example of turning is shown at *B* in Fig. 9. This is a machine steel blank shaft for a lathe lead-screw and the time, in this case, was 6 hours for turning the shaft all over.

Threading Operations

It is well known in machine shop practice that thread milling is the most economical method of producing threads

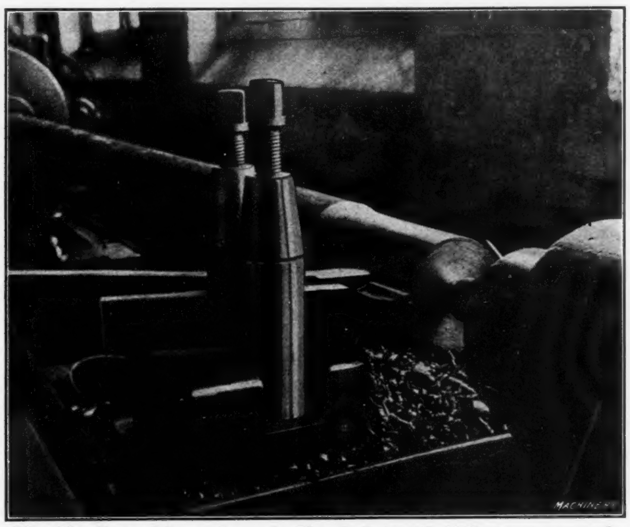

Fig. 10. Same Job as shown in Fig. 8, but with Follow-rest removed to show Tool Settings

where the sizes are beyond the capacity of threading dies. However, there are many cases when the shafts to be threaded are too large in diameter or too long to be handled by a thread milling machine. In such cases thread chasing in the engine lathe must be resorted to. Fig. 11 illustrates a time-saving method of thread cutting in an engine lathe. The work is rigidly supported by two follow-rests, the rest *A* being used in addition to the regular rest *B*. The utility of the special tool-slide *C*, having T-slots for front and rear tool-posts, is also indicated. A tool-slide of this design is more rigid and suitable for the purpose than the regular compound tool-slide.

When roughing out, the thread tool *D* is used for the forward cuts and tool *E* cuts on the reverse. This scheme saves the time usually lost in running the lathe carriage back for

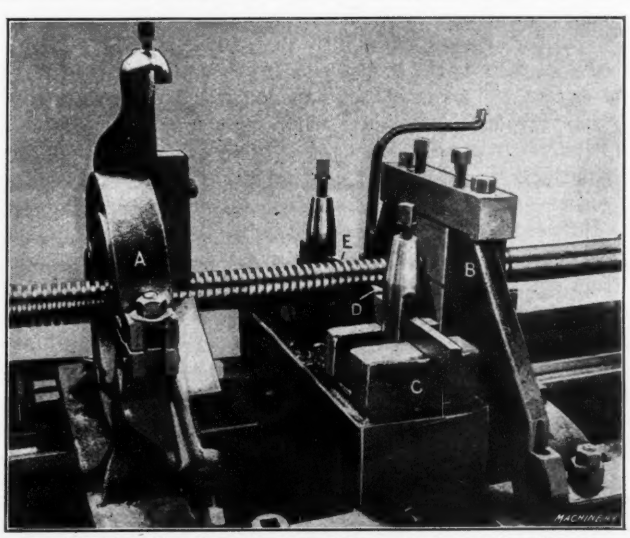

Fig. 11. Threading Operation, using Two Tools to permit cutting on both the Forward and Reverse Movements of the Carriage

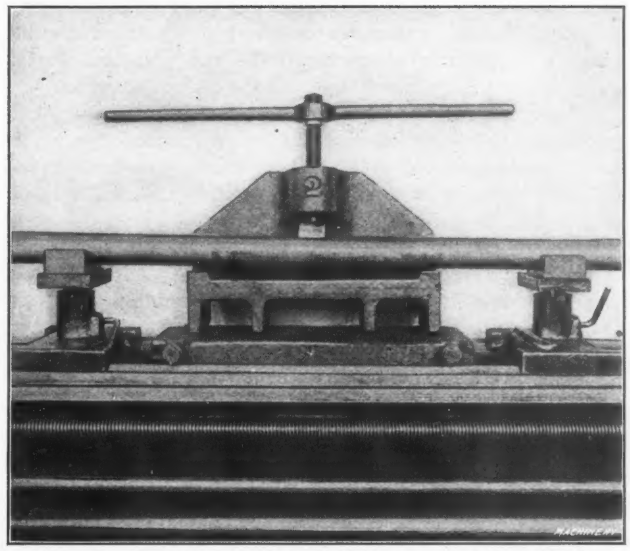

Fig. 12. Hand-operated Shaft Straightener, mounted on Truck which fits Lathe Bed

the next cut. During the last two or three finishing cuts the front tool only is used.

Straightening Operations

To quickly and accurately straighten a long shaft requires considerable skill and experience. A shaft may run out at a certain point but the trouble there may be caused by eccentricity somewhere else. The best way is to find the point of greatest eccentricity and straighten there, and then proceed in the same manner until the shaft runs true everywhere. It really is a process of elimination. All long shafts have to be straightened before the turning operations, and all such shafts require more or less straightening after turning.

A hand-operated straightener of convenient and powerful

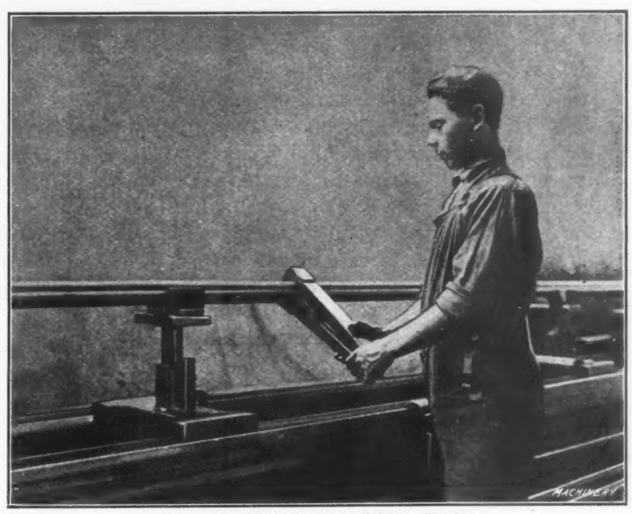

Fig. 13. Method of polishing Shafts

form is shown in Fig. 12, and as will be seen, it is carried on a suitable carriage running on wheels that fit the lathe bed. The shaft supports are easily moved when required.

Polishing Shafts

The polishing operation, which is clearly illustrated in Fig. 13, is so simple as to need little explanation. The emery cloth is folded and lies between the two hard wood blocks which are joined at one end by a piece of leather. Oil is used and the outfit really becomes a lap.

Sizes of Stock for Shafts

In ordering rough stock for shafts it is advisable, when conditions permit, to leave as little stock as possible for turning, for by so doing not only is stock saved but greater production results. As a general proposition it may be stated that 1/16 inch in diameter is sufficient for finishing, when the shafts are properly straightened. It is good practice when designing shafts to use sixteenths for the finished maximum diameter, *i. e.*, 1½-inch diameter machine steel should be used for a 1 7/16-inch finished shaft; 2-inch stock for 1 15/16-inch shaft; 2 3/4-inch stock for a 2 11/16-inch shaft, etc.

Summary

Summarizing the principles referred to in the foregoing, we may consider the following to be the principal factors tending toward economical and efficient shaft turning.

1. Shaft turning, being a special branch of lathe work, requires specially trained and skillful workmen.

2. Accurate and powerful lathes are required to handle the heavy cuts. Motor-driven lathes are preferable on account of their flexibility and convenience.

3. Rigidity of the follow-rests is essential for heavy cuts.

4. An ample supply of high-grade, high-speed steel tools, properly ground in the tool-room, is absolutely necessary for proper results.

5. Abundant tool lubrication is required, and this is best supplied by a system of pump, pan, and piping.

6. A specially designed tool-slide having T-slots for front and rear toolposts saves time, as it enables a rear tool to be used during the reverse movement of the carriage when threading.

7. Accurate sizing is essential to save filing.

8. Care should be exercised when ordering stock so that there is a minimum amount of stock to be turned from the maximum diameter.

By using the tools and methods previously described and illustrated, results will be secured that will increase production fully 200 to 300 per cent over the average shop methods. No mention has been made of the grinding process for finishing shafts because the class of work covered by this article either does not require the high degree of accuracy produced by the grinding method or the shafts are beyond the capacity of any grinding machine on the market today.

* * *

TRADE SCHOOLS—THEIR STRONG AND WEAK POINTS

BY CON WISE

The state aided trade schools of Massachusetts cater largely to the machinists' trade and only one—that at Northampton, which is primarily an agricultural school—does not offer courses in it. In the others, it was the first trade to be taught and still draws more pupils than any other one trade. This is probably due to the facts that Massachusetts needs large numbers of skilled mechanics in its machine shops, and that in spite of the comparatively small wage offered to machinists in that state, the prospects of a capable mechanic are good. Massachusetts has of late years been a fine recruiting ground for industries in the Middle West, where a more liberal spirit both in money and social surroundings has made a great appeal. In turn, she has tried to recruit from the north of Europe, but she finds that she is only a way station for these men on their journey toward the setting sun. Now she is trying to bring up her youth the way they should go. Whether she will be able to fill the demand from the West, so that there will be no place there for her sons to go, or whether she will wake up to the situation and offer inducements enough for them to stay at home is an open question. In the meantime the experiment which the state is trying is an interesting one, irrespective of the destination of the graduates.

A recent trip which I took around the more prominent of these schools made me believe that they are suffering from certain unnecessary handicaps, which are inherited from the older ideas of machine shop practice and from antiquated school methods. The first of these handicaps finds expression in the employment of so many toolmakers as instructors. The result is that wherever I went I saw work being done at a snail's pace, even when the machines and the work would stand high speeds and liberal feeds. It seems to be characteristic of New England toolmakers that they should look upon a piece of tool steel with a sort of reverence, as something which should not be unduly disturbed, for fear that it would not harden properly if anything was done to it hurriedly. Time is something that has no meaning to them, and rightly so in one way, because the time spent in making a tool is spread over so many pieces on which it may be used that its cost may sink into insignificance. On the other hand, when we stop to think that time lost can never be recalled, it seems a pity to allow a machine to run slowly, when, without any extra labor, it might run quickly. The effect on the pupils in these schools is the thing which is more deplorable than any consideration of time wasted on the product. The output of the schools is, or should be, machinists. If they are educated in slow ways of doing work, there remains something to be added to their education in the shops to which they go, that should not be necessary. The reason why so large a proportion of former toolmakers are selected for teachers is twofold. First: it is easier to get men who look the part from tool-rooms than from the general shops; second: there is a scarcity of all-around men in the general shops to draw from. There is no doubt that this is true. A general machinist with an all-around training, if he has some executive ability, usually finds an opening that pays better than any school can afford to.

The other handicap under which these schools labor is inherited from manual training schools. The usual school committee man can see no difference between manual training and trade work. It is the custom to ask a manual training teacher to make requisition for all supplies during the summer vacation, and he orders so many thousand feet of pine shorts and so many kegs of nails, etc., knowing that if he does not get his supplies then, when he needs them some other department will have used the money. Imagine doing things on that basis in a going shop? In August the owner comes around and wants a list of all the castings that you are going to want in the next ten months. If you order a dozen gears and spoil one, you wait till next year to get a new casting. If a customer who wants some work done comes in, you tell him that next year you will order in the castings and get right at the job. This is not an exaggeration. There is, of course, no doubt but that it should be possible for the head of the machine shop to send up to the foundry for castings to be delivered hot the next morning, just as he would in any other shop. It should be possible to buy any supplies without more than a day or two delay. The school committee could keep an all sufficient oversight of expenditures if they simply appropriated so much for the year's supplies and then checked up the bills to see that the account was not overrun. In one school I found that the only way they had of getting castings was by trading with a foundry. The school would do certain work, in exchange for which the foundry would supply castings. The work was not just what the school needed but it served a purpose.

The schools are doing a wonderful work when the handicaps under which they labor are taken into consideration. There is hardly a school that has a very definite aim which it is sure it will be allowed to carry out. They are all hard put to find suitable work. In this they are as much handicapped by their friends as their enemies, if they may be said to have any of the latter. The work which is offered them, and which they sometimes feel obliged to take, regardless of consequences, is often of a more difficult nature than the good of the pupils demands. They require large amounts of very elementary work—lathe work especially—on which the boys can be kept busy until they get the habit of doing careful work. A relatively small proportion of advanced work is needed, because that can only be done by the boys who stay through the course, which cannot be expected to be more than half of those that start. The question of whether these schools can turn out machinists is amply proved by the positions which their graduates get and hold. They go into the best of shops, take hold with the other men, and make good with as little delay as most men experience who go from one shop to another. Possibly this is to some extent on account of these very handicaps. The boys are thrown more on their own resources than they would be if things were running as they ought. At the same time, it costs more for instruction than it should, because an instructor cannot possibly give the time to teaching that he has to devote to digging up work for his pupils to do.

* * *

Iron ore heads the list of Sweden's exports. During 1913 6,440,000 tons were exported to foreign countries, chiefly England and Germany.

PROPORTIONING STEEL HOOPS FOR WOODEN TANKS*

THE ACTION OF WATER PRESSURE AND METHOD OF SPACING HOOPS TO WITHSTAND IT

BY EDMUND B. LA SALLE†

IN connection with the design of elevated wooden tanks and steel towers for supporting them, as discussed in previous articles, there is one other part of such a structure that comes under the province of the engineer, and that is the steel hoops for the tank. There are three types of hoops in general use, the round, half-round and flat, as shown in section in Fig. 1. The round hoop is used more than any other shape, and for tanks used by factories for fire protection none other is permitted by the insurance companies handling that class of risks. Therefore in this article we will consider that type of hoop in our calculations. The method is the same for any other section used as a hoop, except that special calculations to find the net area must be made.

The purpose of the tank hoop is two-fold: to draw the staves tightly together and prevent the tank leaking, and to prevent the tank from bursting on account of the pressure of the water. In large tanks, this pressure becomes enormous. The weight of a cubic foot of water is generally taken as 62.5 pounds, and to arrive at the pressure per square foot for any depth of water, we multiply 62.5 pounds by the depth in feet. For instance, if we wish to obtain the pressure per square foot on the bottom or at the base of the stave of a tank 20 feet deep, it is found to be $62.5 \times 20 = 1250$ pounds per square foot. In calculations relating to this kind of tank, it is more convenient to have the amount of pressure per square foot than per square inch, as will be shown later.

The action of the water tending to burst the tank is shown in Fig. 4, the pressure being uniform in all directions for a given depth below the surface. The effect of this condition

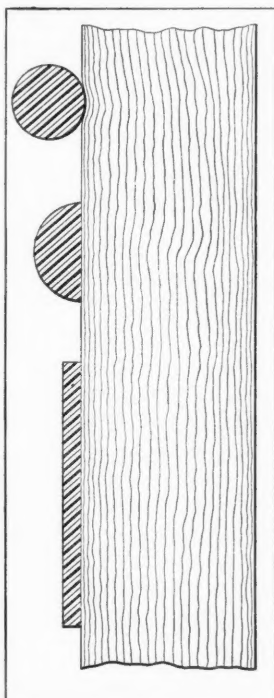

Fig. 1. Types of Hoops used on Wooden Tanks

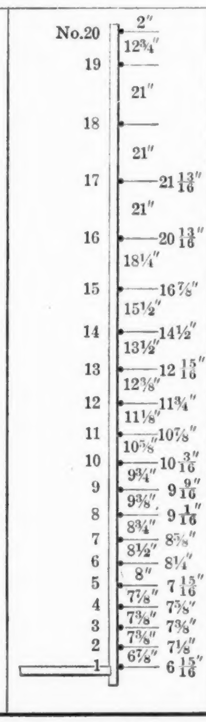

Fig. 2. Preliminary Spacing of Hoops

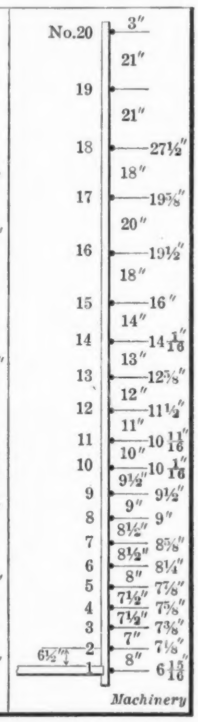

Fig. 3. Adjusted Spacing of Hoops

is shown in Fig. 5. Consider the half circle shown as being a solid of indefinite length; then the effective pressure of the water would act as shown and tend to separate two such halves that the tank is regarded as being made up of, the water taking the place of the imaginary solid substance. The resisting force of the hoops would then have to act in the opposite direction, as shown by the arrows at the circumference of the circle. It falls on the hoops around a tank to resist the total bursting pressure of the water in the tank.

* For additional information on the design of gravity tanks see "Designing Steel Towers for Wood Tanks," published serially in MACHINERY for January, February, March and April, 1913, and other articles there referred to.

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As we have in previous articles taken a tank 20 feet in diameter and 20 feet high for the calculations, we will use the same size here. Owing to the manner of constructing wooden tanks, the depth of water contained will not be identical with the height of the staves because the tank bottom is set up about 4 inches above the lower end of the staves. The bottom of the tank is approximately 3 inches thick; therefore, the water would be 7 inches above the bottom of the staves. In a 20 by 20 foot tank, the actual depth of water when the tank is full would be 20 feet — 7 inches

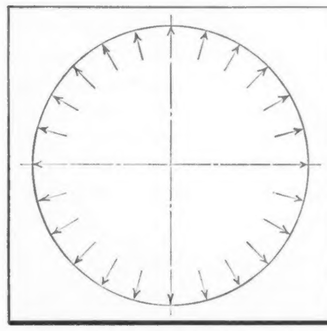


Fig. 4. Diagram showing Action of Water Pressure

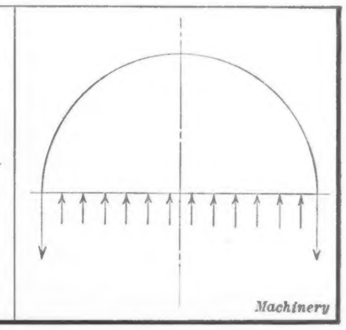


Fig. 5. Diagram showing Effective Water Pressure

= 19 feet 5 inches. This is the depth used in the calculations. The insurance companies specify that on tanks less than 20 feet in diameter one extra hoop must be added at the bottom to take care of the swelling of the bottom. For tanks 20 feet or more in diameter, two extra hoops must be added. In the formulas to follow, we will use the following nomenclature:

D = diameter of water, in feet;
H = depth of water in tank, in feet;
h = depth of water above point under consideration, in feet;
R = radius of water, in feet;
P = pressure supported by hoop or hoops, in pounds;
p = pressure per square foot at point considered, in pounds;
S = safe strength of one hoop, in pounds;
A = total net area of hoops required, in square inches;
a = net area of each hoop;
N = total number of hoops required;
f = fiber stress in pounds per square inch in hoops;
B = vertical surface of stave in feet, supported by a hoop;
b = vertical surface of stave, in inches, supported by each hoop.

The pressure p for any position on the stave is the distance from the surface of the water to that point multiplied by 62.5.

$$p = 62.5\,h. \qquad (1)$$

The average pressure for all the water in the tank occurs at a point half way between the surface of the water and the bottom of the tank:

$$p = \frac{62.5\,H}{2}. \qquad (2)$$

From this formula we obtain the average pressure per square foot exerted by the water against the sides of the tank in all directions, as illustrated in Fig. 4. Then, according to Fig. 5, if we wish to obtain the total effective pressure on the tank at the point under consideration, we multiply the diameter by the pressure per square foot, thus:

$$p = \frac{62.5\,HD}{2}.$$

This gives the pressure exerted on a space one foot wide, that is, vertically on the stave. We now have the average bursting pressure per vertical foot of water; so to get the total bursting pressure we multiply the height of the water by this average bursting pressure, thus:

$$P = \frac{62.5\,HHD}{2} = 31.25\,H^2D. \qquad (3)$$

As there are two sections of the hoops that resist the total bursting pressure, to get the amount of pressure for which the hoops have to be proportioned we divide Formula (3) by 2, then:

$$P = \frac{62.5\,H^2D}{4} = 31.25\,H^2R. \qquad (4)$$

When f is the allowable fiber stress in the hoops in pounds per square inch, the total net area A in square inches required to resist the bursting pressure in Formula (4) would be:

$$A = \frac{31.25\,H^2R}{f} \text{ square inches.} \qquad (5)$$

We have now shown how to obtain the total area of hooping for the tank. Next we must decide how many hoops are necessary. We cannot, as one would naturally suppose, divide the total area required by the net area of each hoop and thereby obtain the required number. There are several reasons, arising from practical considerations, why this cannot be done. The top and bottom hoops, owing to their position, can only take half a load, because on one side they have no load and on the other side they divide their load with the next hoop. For that reason, we lose the value of one hoop. The maximum center-to-center distance of any two hoops, as permitted by the insurance companies that regulate such matters, is 21 inches. In railroad work this distance is exceeded, but a distance of 23 inches should be the maximum for work of any importance. It will be found that, owing to this spacing limit, when the hoops approach the top of the tank they can support more than this limit will allow, and so they do not assist to their maximum capacity in supporting the load. This causes another loss of hoop value. When distributing the hoops, it is not advisable to space them to small fractions of an inch. It is better to take the next lower ¼ inch. From these two causes, it will be found that we lose practically the value of one hoop, and so we lose altogether the value of two hoops for which we must make allowance in our formulas. The theoretical number of hoops required would be found by dividing A by a and when we allow for the two hoops lost through the causes just mentioned, the formula would read:

$$\frac{A}{a} = N - 2 = \frac{31.25\,H^2R}{fa}. \qquad (6)$$

$$N = \left(\frac{31.25\,H^2R}{fa}\right) + 2. \qquad (7)$$

In case the specification requiring one or two extra hoops for the swelling of the bottom has to be adhered to, the formulas could be changed to suit, or the extra hoops added to N in Formula (7). We have now shown how to determine, as nearly as possible, the number of hoops required on a tank; the next step will be to space the hoops on the staves in such a way that no hoop is overloaded and all are doing their share of the work. There is one thing we might call attention to before going further, and that is that the value of N in Formula (7) provides for all hoops to be of one size. It very often happens that it is economical to change the size of the hoops, making them smaller toward the top. Three sizes are sometimes used, but it will generally be found that two sizes are enough, the top three or four hoops being a size smaller than those at the bottom. In such a case, it is best to solve for A in Formula (5); then deduct the combined areas of the three or four hoops at the top and divide the remainder by the area of the hoop it is intended to use. The sizes can be assumed for this purpose and then changed later if they do not space well. If we proceed in this way, we will have to make the additions for extra hoops called for in Formulas (6) and (7) after determining the theoretical number of each size required.

To find how much vertical space in feet each hoop (or set of hoops) will support we use the formula:

$$B = \frac{S}{31.25\,Dh}. \qquad (8)$$

This formula is derived as follows:

$p = 62.5\,h$ = pressure per square foot.

$P = 62.5\,hRB$ or $31.25\,hDB$.

$P = S = af = 31.25\,hDB$.

$$B = \frac{S}{31.25\,hD} = \frac{af}{31.25\,hD}.$$

$$f = \frac{31.25\,DhB}{a}. \qquad (9)$$

$$a = \frac{31.25\,DhB}{f}. \qquad (10)$$

If we wish to obtain the space b the hoop will support in inches instead of feet we multiply Formula (8) by 12, thus:

$$b = \frac{12\,S}{31.25\,Dh} = \frac{S}{2.60417\,Dh}. \qquad (11)$$

We will now take an actual problem of tank design and work it out by the foregoing formulas. As we have in the preceding articles used a 20 by 20 foot tank as an example, we will use the same size in the present instance. The depth of water would, as previously mentioned, be 19 feet 5 inches. The staves are nearer 2¾ inches thick than 3 inches, so, to be on the safe side, we will call the diameter of the water 19 feet 6½ inches. We will use a fiber stress f in the hoops of 12,500 pounds per square inch, as that is common practice, and we can then use Formula (5) to arrive at the total area of hoops required:

$$A = \frac{31.25\,RH^2}{12{,}500} = 0.0025\,RH^2.$$

$$A = 0.0025 \times 19.4167^2 \times 9.77 = 9.209 \text{ square inches.}$$

As a trial we will assume 1-inch round hoops, whose net area at the root of the thread is 0.55 square inch. From Formula (7) we find the number of 1-inch hoops required thus:

$$N = \frac{31.25 \times 19.4167^2 \times 9.77}{12{,}500 \times 0.55} + 2 = 16.74 + 2 = 18.74.$$

Taking the next larger whole number we find it will require nineteen 1-inch hoops. By calculation we find that 1-inch hoops would be much too large at the top, so will assume the four top hoops to be ⅞ inch in diameter. The net area at the root of the thread for a ⅞-inch hoop is 0.42 square inch, the combined area of four hoops being 1.68 square inch.

Then $9.209 - 1.68 = 7.529$ square inches.

This remainder is the theoretical area of the 1-inch hoops required in addition to the four ⅞-inch hoops at the top.

Then $\frac{7.529}{0.55} = 13.69$ = theoretical number of 1-inch hoops necessary. Calling that number fourteen and adding two, as usual, we find we need sixteen 1-inch hoops and four ⅞-inch hoops. The next operation is to give the hoops their proper spacing, and we always begin at the bottom in doing this, as it works out best in that way. The number of inches of stave each hoop will safely support is found by Formula (11).

$$b = \frac{S}{2.60417\,Dh}$$

where $S = af$.

Substituting in this formula for 1-inch hoops we have:

$$b = \frac{0.55 \times 12{,}500}{2.60417 \times 19.5417\,h} = \frac{135.1}{h}.$$

Resolving the formula thus to its simplest form facilitates the computations, and the designer can use the slide-rule if he chooses, which will lessen the work still more. The use of logarithms is the easiest way if greater accuracy is desired. For the ⅞-inch hoops we would use the same formula with the following substitutions:

$$b = \frac{0.42 \times 12{,}500}{2.60417 \times 19.5417\,h} = \frac{103.17}{h}.$$

The first hoop at the bottom of the tank would be placed in the middle of the bottom but, as far as resisting the water pressure is concerned, it would be 19 feet 5 inches from the top; therefore, the space the first hoop is able to support is:

$$b = \frac{135.1}{19.4167} = 6.958 \text{ inches} = 6\ 15/16.$$

The bottom hoop is given only a half load, to permit it better to resist other stresses that occur at that place, such as swelling and increased stresses due to tightening. This may be true of any hoop, but the bottom hoops are likely to be pulled up tighter than the others. In the following calculations, we will take the value of the hoops to the nearest lower 1/16 inch and the spaces will be worked out to the nearest lower $\frac{1}{8}$ inch. This will be a greater refinement than is usual, as the nearest $\frac{1}{4}$ inch is considered close work. However, in order to illustrate the values obtained by the formulas as nearly as possible, we will use dimensions to the limits above mentioned. Referring to Fig. 2 it will be found that the second hoop from the bottom (marked 2) is placed $6\frac{7}{8}$ inches from the first hoop. As the space or load between the hoops is taken equally by them, it can be seen that hoop No. 1 gets 3 7/16 inches, which is a half load, as previously mentioned. In Fig. 2, hoop No. 1 is shown even with the upper surface of the tank bottom, or 19 feet 5 inches from the top. This is to permit of the calculations being followed more easily. However, if the specifications calling for extra hoops to take care of swelling are adhered to, this position could be the same for one extra hoop, but should be raised slightly if two extra hoops are used. Otherwise, the hoop should be placed as shown in Fig. 3. The depth of water above the top of hoop No. 2 is then 19 feet 5 inches $-6\frac{7}{8}$ inches $=$ 18 feet $10\frac{1}{8}$ inches.

The value of b for hoop No. 2 is $\frac{135.1}{18.8437} = 7.169 = 7\frac{1}{8}$ inches.

To arrive at the space between hoops No. 2 and No. 3, and give hoop No. 2 the full load it is capable of holding, we subtract half the space below hoop No. 2 or 3 7/16 inches from $7\frac{1}{8}$ inches and get 3 11/16 inches. Doubling this we have $7\frac{3}{8}$ inches for the next space. The same result can be obtained by doubling the value of the hoop, $7\frac{1}{8}$ inches, which gives $14\frac{1}{4}$ inches; and then subtracting the space below, or $14\frac{1}{4} - 6\frac{7}{8} = 7\frac{3}{8}$. This method is simpler. Continuing our calculations in this way for each hoop, we find that when we get to hoop No. 19 we have only $14\frac{3}{4}$ inches left and one more hoop to add. The top hoop should be from 2 to 4 inches from the top of the stave. Using 2 inches makes the space above hoop No. 19 only $12\frac{3}{4}$ inches. This does not give it a full load or, in other words, it is not assisting to its full value to resist the load.

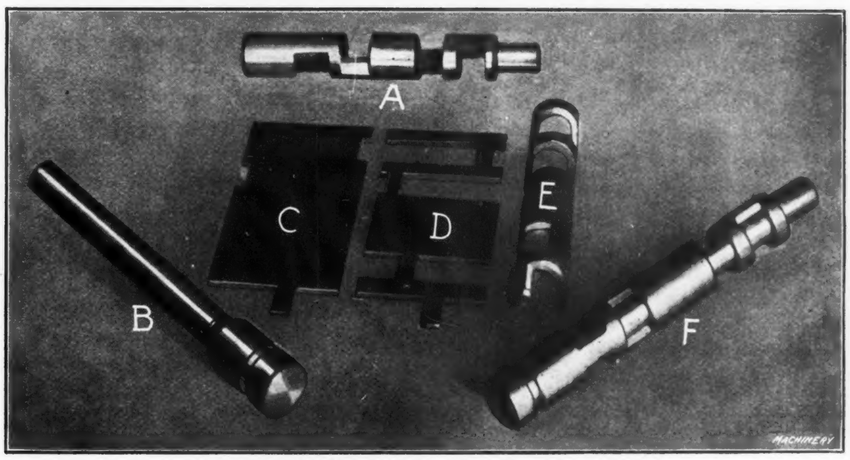
It is preferable, however, to so space the hoops that the lower ones will be underloaded rather than the top ones. With this in view, we proceed to respace the hoops as shown in Fig. 3, which gives a more uniform loading throughout. We have omitted all the small fractions of an inch and used nothing closer than $\frac{1}{2}$ inch, which is better in practical work although, if the value of the hoops is very close to the total load, we may have to use eighths of an inch in order to have the hoops come out right at the top. In the case just worked out, there was some strength to spare, so it came out well even if a trifle of the value of each hoop was lost, as in Fig. 3. The nearer we make the spaces equal the theoretical value of the hoops, the higher we will raise each succeeding hoop, as is demonstrated by the case illustrated in Fig. 2. Had we used the exact value in decimal parts of an inch, we would have raised hoop No. 19 still further—perhaps 2 inches—but it would not have been enough to allow us to leave out a hoop. So in justice to the other hoops, *i. e.*, to better distribute the load, we respace them. There are times when it will be all we can do to make the hoops selected suffice, that is, when there is no strength to spare.

CRANKSHAFT MADE ON THE SCREW MACHINE AND PUNCH PRESS

In designing the tools for manufacturing the parts of an automobile starter, the Sloan & Chace Mfg. Co., Ltd., of Newark, N. J., was looking for some way to manufacture the crankshaft shown at *A* in the illustration.

The work which this small crankshaft does, which is $\frac{5}{8}$ inch in diameter and 4 inches long, is simply the moving of plungers for a very slight distance. These plungers are entirely free from the crankshaft and as their ends are beveled the throws need not be finished in order to act satisfactorily against the plunger ends.

These crankshafts were formerly made by milling, but a milling operation of this kind is somewhat expensive and the tools required would not be simple, to say the least. It was therefore proposed by the engineering department that the piece be made a combination of a punching and a screw machine shaft. Therefore the shaft was turned out after the manner shown at *B*, and then a punching was made, the blank for which is shown at *C*. This punching was pierced as at *D* and then bent up into semicircular shape as shown at *E*. At this point a closing die wrapped the partly formed punching around the shaft in such a manner that it would be held tight. The result is shown at *F*.



Making a Crankshaft with a Punching and a Shaft

It will be noticed that the piercing of the blank is done so that the throws will be made by the edges of the punched slots. Referring to *E*, it will be seen that these slots are of different depths, thus giving the throws the right sequence. This solution of the problem proved to be a far easier manufacturing proposition than milling, and the combined punching and shaft was as effective as a milled crankshaft. C. L. L.

* * *

PANAMA-PACIFIC INTERNATIONAL EXPOSITION NOT TO BE POSTPONED

President C. C. Moore of the Panama-Pacific International Exposition at San Francisco, has issued a statement to the effect that the directors have no thought of postponing the opening date of the exposition on account of the European War. The exposition will open February 20, 1915, as scheduled, and will close December 4. Forty-four states have made appropriations and are engaged in building state pavilions and preparing their exhibits. The exhibit palaces are completed and installations are now being made on a large scale. Thirty-four foreign countries have made appropriations and are erecting their official buildings and preparing exhibits, regardless of the war. The management of the exposition points out that this is a great opportunity for the United States to advertise her products and to extend her commercial relations with those countries with which she has heretofore had little dealings. The operation of the new regional banks and the added number of American ships making quick time from coast to coast through the Panama Canal places the United States in a most favorable position to capture the world's commerce. The exposition offers the best medium for bringing American manufactured products to the attention of distributors and consumers of the world.

* * *

Endurance tests for automobiles, the prizes for which are to be orders for winning cars, have been held by the Russian army authorities. The first prize will be an order for 250 cars, the second, an order for 150 cars, the third, for 100 cars, and the fourth, an order for 50 cars.

THE MANUFACTURE OF "VEGETABLE IVORY" BUTTONS

DRYING THE NUTS, CUTTING THE BLANKS AND MAKING THEM INTO FINISHED BUTTONS

BY RICHARD WILCOX*

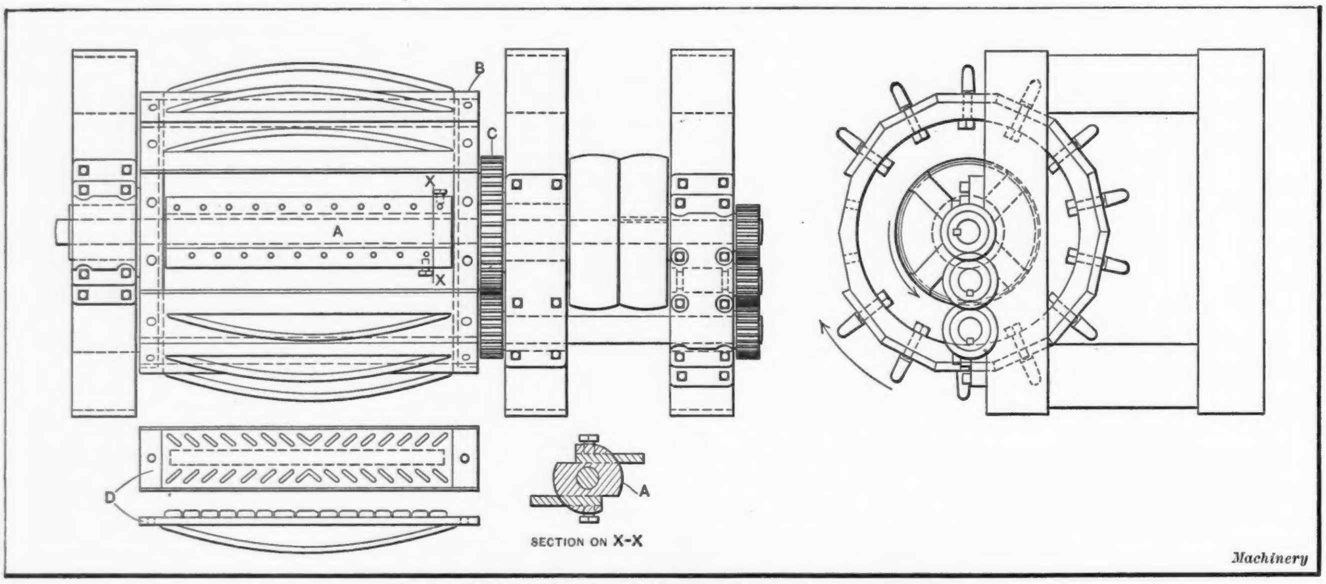


Fig. 1. Tumbling Barrel in which the Tagua Nuts are cleaned

About fifty years ago a party of rubber gatherers in northern Ecuador found great numbers of a previously unknown palm, which bore nuts somewhat resembling in shape and color a diminutive negro's head. These nuts were termed "negritos," but later the term "tagua" nut was applied to them, this being the name now generally used. The nuts are about the size of a hen's egg. Experience showed that the kernel of the tagua nut assumed the color and texture of dentine ivory upon being dried, and this material is now used as a substitute for real ivory in making buttons and small ornaments of various kinds. It can be sawed, carved and turned on a lathe, and it will take a high and permanent polish. The texture of "vegetable ivory," as it is called, is also such that it absorbs dyes freely, thus lending itself to the production of various forms of colored buttons. An idea of the importance of the discovery of this material may be gathered from the fact that 20,000 tons of tagua nuts, representing $1,700,000, are shipped annually from Ecuador. There are twenty-three factories in the United States engaged in the manufacture of vegetable ivory buttons and these factories use 10,000 tons of nuts per year.

A substitute for the South American tagua nuts is found in Africa. The "vegetable ivory" obtained from this source has been tested by many of the button manufacturers in Italy, but the results have shown it to be decidedly inferior to the South American product. Some ten or twelve tons of these African nuts have been sold in the United States but these have been merely trial lots and the orders have never been repeated. The African nuts cost about one-third the price of those shipped from South America. The difficulty with the African vegetable ivory is that after it has been made up into buttons it shows a decided tendency to shrivel and warp, thus seriously impairing the appearance of the buttons made from it.

It is the purpose of the present article to describe the methods used in the manufacture of these buttons, and the subject will be treated according to the sequence of operations involved. The first step consists of drying the nuts in a kiln, and in order to get the best results the temperature must not be too high; the slower the nuts are dried, the better. When thoroughly seasoned, they are put in a tumbling barrel or "shucking machine" which removes most of the outer scale. One of the machines employed for this purpose is illustrated in Fig. 1. This consists of a central cylinder *A* which has two plates extending out from it. Surrounding this cylinder is the barrel *B*, to which the driving

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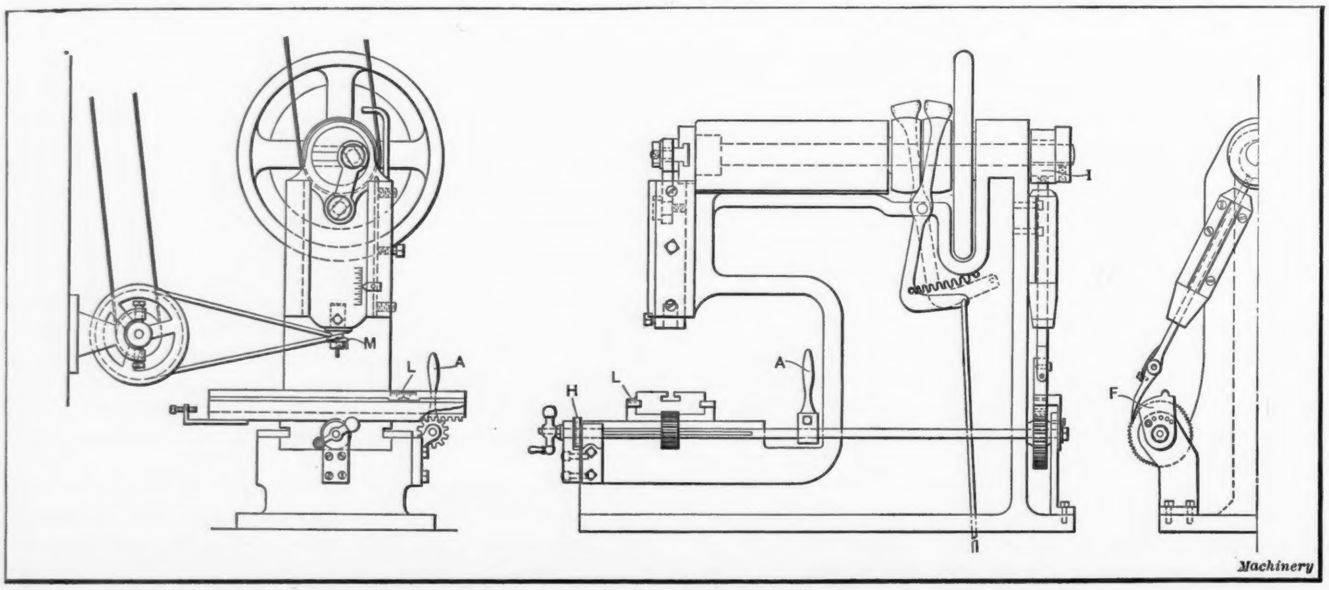


Fig. 2. Die-sinking Machine for finishing Dies used in making Fancy Buttons

gear C is bolted. The arrangement of the drive is such that the cylinder A and barrel B rotate in opposite directions, with the result that the nuts are tumbled over and over, and in this way most of the outer scale is removed. After the tumbling operation has been completed, two of the staves D are removed from the barrel to enable the contents to be taken out.

The small amount of scale that remains on the nuts must be removed by hand, as it is very hard and would dull the saws and tools used in subsequent operations. With all the scale removed, the next step is to cut the nuts into blanks from which the buttons are made. For this purpose, the sawing machine illustrated in Fig. 10 is used. The side of a nut is placed under the projecting fork on the slide A and held with the left hand, while the right hand pushes the slide forward, thus carrying the nut against the saw. With this arrangement there is not so much danger of the workman's being injured as there would be if the saw were not equipped with a feed-slide of this kind.

The machine shown in Fig. 3 is used for turning the blanks

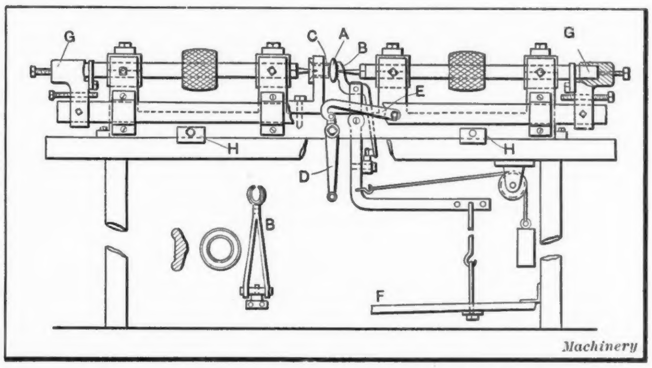


Fig. 3. An Improved Design of Button Turning Machine

to the required shape, ready for the final operations, which are drilling and pressing. Referring to this illustration, it will be seen that the blank A is placed between an adjustable grip B and a stationary grip C. The turning tools are controlled by the handle D which brings them forward to turn the button and cut away the surplus stock. Connecting-rod E is bent in order to make the cutting tool move very slowly when finishing the face of the button. After completing the operation, the treadle F is depressed, allowing the finished button and the scrap to fall out from between the grips so that a fresh blank can be put into place. The spindles are backed up by lignum-vitæ plugs G. This wood is hard and rosinous; and it has been found to stand the end-thrust better and run more smoothly than any other material. Adjustments H are provided for regulating the belt tension. It will be seen that the pulleys are knurled, and despite the fact that it is generally conceded that a belt runs more evenly over a smooth pulley, we found that the knurled pulleys gave better satisfaction on this machine. The pulleys are not flanged because the belts would run against the flanges when the spindles moved back and forth and cause vibration. Flanged pulleys were tried, but it was found that the vibration showed itself in the form of tool marks on the work. In order to get the most satisfactory results it is particularly important to maintain the belt tension at exactly the right point.

A detail of the grip B which holds the blank is shown in Fig. 3, and Fig. 4 shows enlarged views of the turning tools

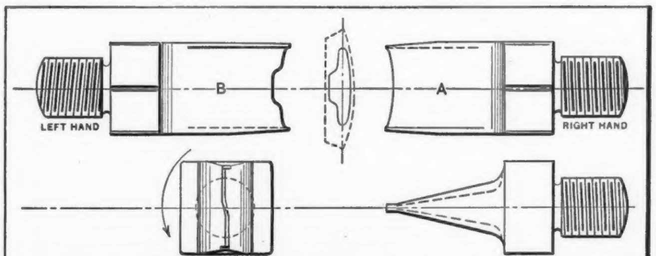


Fig. 4. Turning Tools used in the Machine shown in Fig. 3

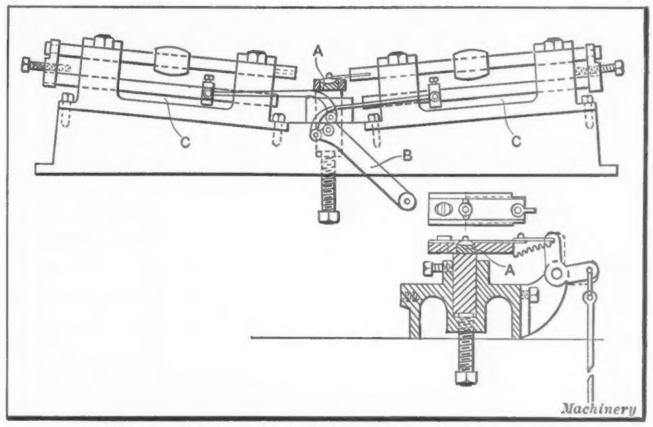


Fig. 5. Machine for drilling and counterboring the Shanks of Buttons

which form the two sides of the button. These tools work in the spaces at the center of the grips and cut the finished button, which is shown by full lines in Fig. 4, from the blank, shown dotted. The turning tool A in this illustration is brought forward against the work until the face of the button is formed, the movement of the tool being controlled by a stop. Then the tool B which forms the back of the button comes forward, and when this tool has finished its work the button is cut free from the blank, leaving a ring of scrap between the grips B and C of Fig. 3. This scrap

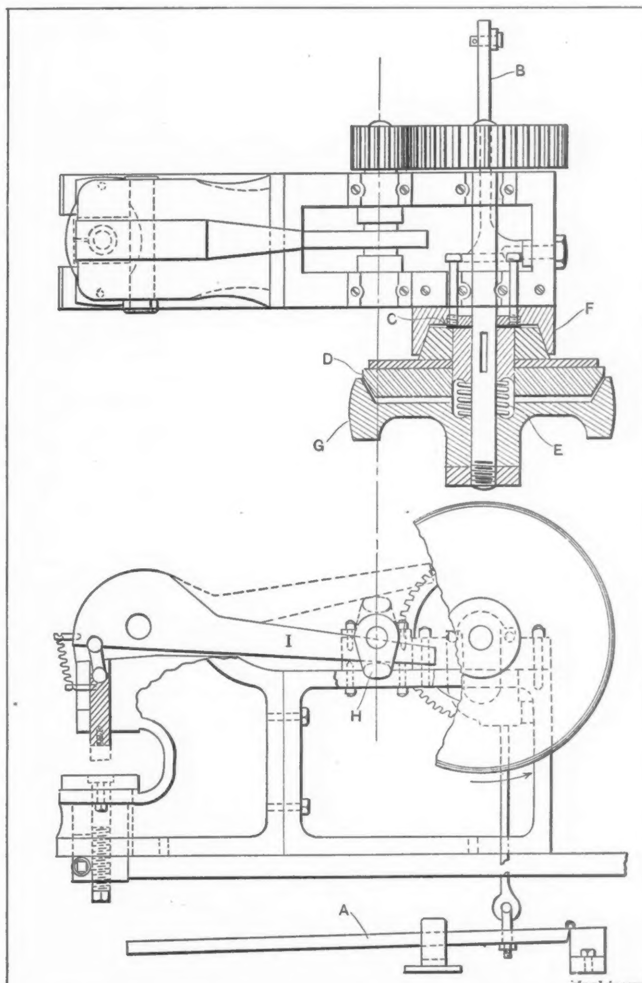


Fig. 6. Special Power Press used for making "Vegetable Ivory" Buttons

drops out when the grips are opened. These forming tools scrape rather than cut the work and it requires considerable skill to grind and oilstone them so as to leave a good finish on the work. The tools must also finish the button to the required shape and size to fit in the pressing dies in which the final operation is performed. These turning tools are made of the best grade of tool steel and carefully forged by hand. In hardening them, the points are heated about 3/4 inch and then dipped quickly in and out of the cooling water

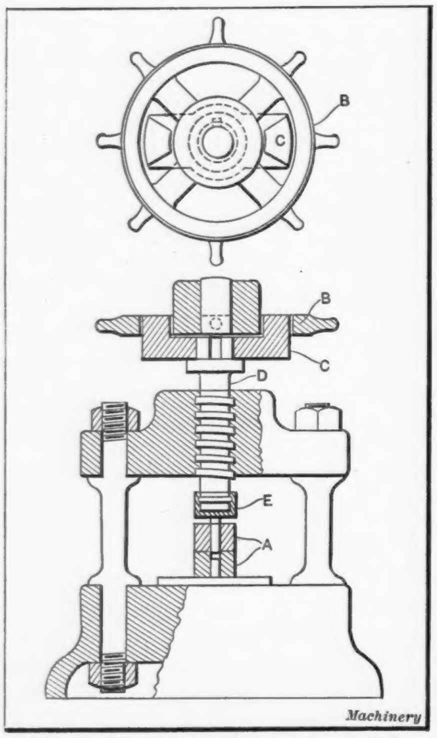


Fig. 7. Screw Operated Press for making Button Dies

until the steel has been thoroughly quenched. In this way, cracks in the steel are avoided and the required degree of hardness is obtained.

Fig. 5 shows a machine for drilling and counterboring the holes in the shanks of the buttons after the blanks have been turned to the required form. The best results are obtained by drilling these holes at a slight angle, this work being handled very satisfactorily by the two-spindle machine designed especially for this purpose. The button blank is held by the sliding jaw of a chuck mechanism, the face of the button being set against a wooden block *A* shaped to receive it. The chuck is opened by pressing down the foot treadle shown in the cross-sectional view, and a coil spring is provided which closes the chuck automatically. The movement of the spindles is controlled by connecting-rods operated by the lever *B*. The rate of feed obtained by moving the operating lever at a normal speed is such that it is seldom that the combination drilling and counterboring tools used are broken. It will be evident from the illustration that the movement of the connecting-rods is transmitted to the spindles through the guide rods *C*, both the guide rods and spindles being an easy fit, so that the machine acts very smoothly. In some cases it has been found advisable to provide a glass shield to protect the operator's eyes from the sharp cuttings.

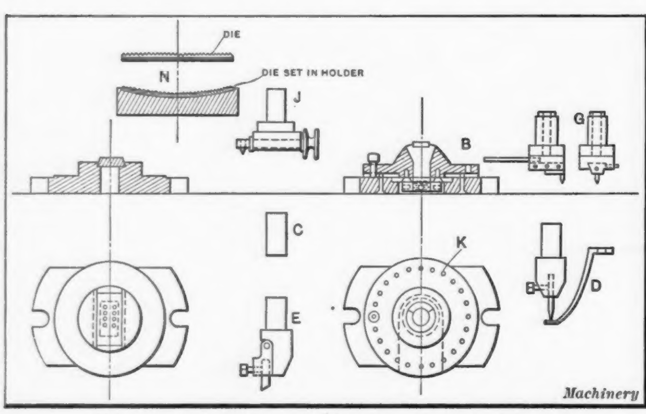


Fig. 8. Tools used in the Machine shown in Fig. 2

Fig. 6 shows a special power press for finishing the button blanks turned on the machine illustrated in Fig. 3. This power press represents the result of years of experimental work. The buttons are formed in a punch and die, and experience has shown that the punch should come down slowly and be held stationary at the bottom of its stroke, to maintain the maximum pressure for a sufficient length of time to allow the material to take the desired form. A quick action of the punch would not give satisfactory results. The press used for this purpose must be very strong in addition to being equipped with a suitable mechanism for controlling the operation. The design of the machine shown in Fig. 6 has been worked out so that the ram can be stopped in any position and backed up by hand. As soon as the pressure is taken off the treadle *A*, the lever *B* is released; and this, in turn, releases the collar *C* and friction clutch *D*. The spring *E* then comes into action and throws the friction clutch into contact with the brake cup *F*, stopping the ram almost instantly. It will be evident that, in the running position, the friction clutch is in contact with the driving pulley *G*.

In operating this press, the die is carried by a holder screwed into the ram and a small gas flame is allowed to impinge against the die. When the die has been warmed sufficiently in this way, work can be commenced, experience having shown that better results are obtained with the die warm than cold. The die is kept warm by the flame during the period that it is in use, and in the event of its becoming smoky or dirty, it must be immediately cleaned with gasoline or some other means. The girls who run these presses become expert, and are able to eject the finished button with a small hard-wood stick and put a fresh blank in the die during the brief "dwell" that occurs at the top of the stroke. This "dwell," and also the period that the ram remains stationary at the bottom of the stroke, is obtained by means of the oval-shaped cam *H* which operates the lever *I* that governs the movement of the ram. The presses are kept running continuously for extended periods of time, but in the event of a button's sticking in the die after being pressed, the machine can be instantly stopped by releasing the treadle *A*, which disengages the clutch as previously described.

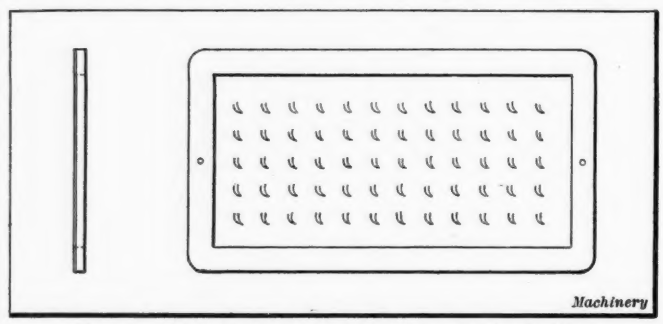


Fig. 9. "Chart" for use in spraying Dye onto the Buttons

The press shown in Fig. 7 is used for making duplicate button-forming dies from the master embossing dies. The master dies are set between the holders *A*, and the large handwheel *B* is turned until it comes in contact with the nut *C* which is keyed to the screw *D*. By swinging the wheel back and bringing it forward with a quick jerk against the nut *C*, a heavy blow can be struck. The hardened collar *E* at the bottom of the screw turns freely. A press for making dies in this way should be of exceptionally rigid construction to enable it to stand up under the severe service for which it is intended.

Another machine for producing dies used in button manufacture is illustrated in Fig. 2. This is the outgrowth of various designs of machines for making embossing dies. Some of the buttons manufactured in these dies have matting designs done in fine lines, scrolls and other ornamentation, all of which must be produced by the die. In making dies for the manufacture of these various kinds of buttons, it is necessary to have a machine possessing a wide range of adjustment. In order to obtain the best results it is also important for the

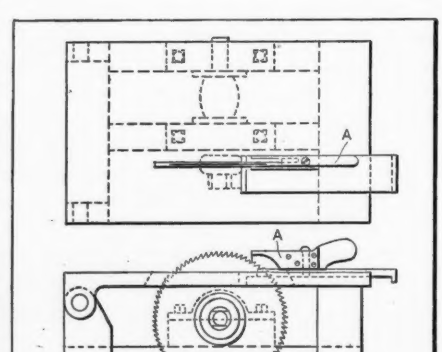


Fig. 10. Type of Saw used for cutting the Nuts up into Button Blanks

die to be finished as far as possible in a single setting. This can be done on the machine shown in Fig. 2 by using different forms of tool-holders, as shown in Fig. 8; and dies can be duplicated by keeping a record of the movements, as obtained by the indexes *H*, *K* and *L*. In operation, the table of the machine is worked back and forth by means of the handle *A*, and this movement, in connection with the cutting tool in the holder *E*, Fig. 8, constitutes the equivalent of a shaper. In this way fine lines are cut across the die-block. The spacing is controlled by the index *H*.

The feed is driven by the cam *I* on the main cam-shaft and can be regulated by moving the cover *F* forward or back

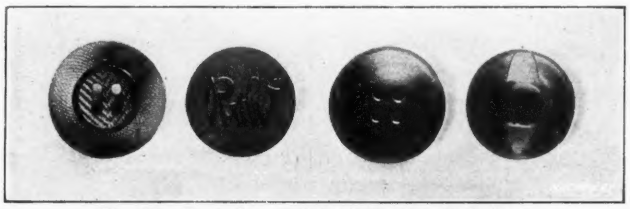


Fig. 11. Examples of "Vegetable Ivory" Buttons

in order to expose the required number of teeth on the ratchet wheel. When it is desired to disengage the feed, the cover *F* is set forward so that the pawl will ride over the face of the cover without engaging with the teeth. The dies produced on this machine are made from a fine grade of machine steel, although some shops have used very hard brass and obtained satisfactory results. The block from which the die is to be made is cut from bar stock and faced in the lathe, after which it is set up in a draw-in chuck *B* which is shown in detail in Fig. 8. This chuck has previously been located centrally on the table of the machine by inserting the plug *C* in the hole in the ram of the machine; this plug enters the chuck and locates it in position, after which it is securely bolted to the table. When the chuck has been centrally located, the readings of the indexes *H* and *L* in Fig. 2 should be recorded. If the die is to have fine lines cut on its surface, they can be produced in the manner previously described. The index *K* on the face of the chuck is used for cutting scrolls on the die and for other operations. The tool-holder *J*, Fig. 8, can be used with a fly-cutter, and tool-holder *G* can be employed for making cuts with the hand feed. The fine matting so often seen on buttons can be produced by machining the die with a matting tool of suitable form which is held in the tool-holder *D*. The die is cut flat and must be made to conform to the face of the button, which is usually convex. This is accomplished by turning down about 5/32 inch extra stock which is left for chucking purposes, leaving the die only 0.025 inch thick. This thin metal is then pressed over a form of the shape of the button that is required, as illustrated at *N* in Fig. 8.

The screw-operated press shown in Fig. 7 is also used in connection with a suitable die-block for making "spraying charts," as they are called, one of which is illustrated in Fig. 9. The charts are used for spraying dye onto the buttons. They are made of sheet brass which is punched with a series of holes, as shown in the illustration, after which it is soldered onto a cast-iron frame. The buttons to be sprayed with dye are placed on a board which is counterbored to receive their backs, and the charts are arranged over the buttons. The layout of the holes in the charts corresponds with the positions of pins in the board, thus bringing the buttons directly underneath the openings. Dye of a suitable color is then sprayed over the charts by means of an instrument somewhat similar to an artist's air-brush but larger in size, giving the buttons a mottled appearance.

TUBE MAKING IN A PUNCH PRESS*

PUNCHES AND DIES FOR PRODUCING AN AUTOMOBILE GASOLINE TANK FILLER

BY DOUGLAS T. HAMILTON†

The making of a small tube from sheet tin 0.01 inch thick, 15¾ inches long and ⅞ inch in diameter is quite a proposition. A tube two or three times larger in diameter and one-half the length would not be quite so difficult to make, as the increased length and correspondingly decreased diameter, of course, complicates the problem considerably. This tube, which is shown assembled with the funnel in Fig. 2, is used as a filler for a gasoline tank for an automobile, and the punches and dies for producing it were made by the Acklin Stamping Co., Toledo, Ohio. The tube part *A* of the filler is made from sheet tin, and is formed into tube shape in one operation in the punch press. Before the tube can be formed it is necessary to first trim the end of the strip to the shape shown at *B* in Fig. 3, and then crimp the edges as shown at *C* in order to produce the seam. As this illustration shows, the tube starts out with a flat sheet of metal 3¼ inch wide by 15⅞ inches long.

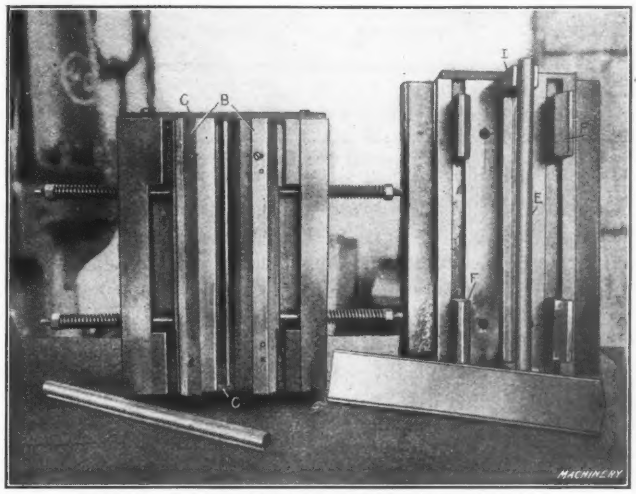


Fig. 1. Tube Bending Dies of Unusual Construction

The first operation after the sheet has been prepared by shearing is to trim the end to irregular shape in order to form an angle of 15 degrees. When the sheet is bent into tube form, then the two edges are turned or crimped as indicated at *B* and *C* in Fig. 3. This is accomplished in the die and punch shown to the left of the illustration Fig. 5, and is one of the operations that required considerable experimenting. As can be seen from this illustration, the die and punch are simply blocks of steel shaped to the form required on the blank. Both edges of the blank are formed in this one punch and die, there being two different impressions for accomplishing this purpose. The sheet, before and after crimping the edges, is shown at *A* and *B*. After the edges have been formed in the manner illustrated at *B*, to produce the seam, the next operation is the drawing up and forming of the tube. This is done in one operation, but to clearly illustrate the various steps, the important changes in shape are shown graphically in Fig. 3.

The punch and die used for forming this tube is shown in Figs. 1 and 4. Fig. 1 shows a view of the faces of both punch and die, while Fig. 4 shows a sectional view and illustrates the construction of these tools most clearly. The member *A*,

* For additional information on punch and die work published in MACHINERY, see "Cluster Double-action Punches and Dies" in the December, 1913, number, and other articles there referred to.

† Associate Editor of MACHINERY.

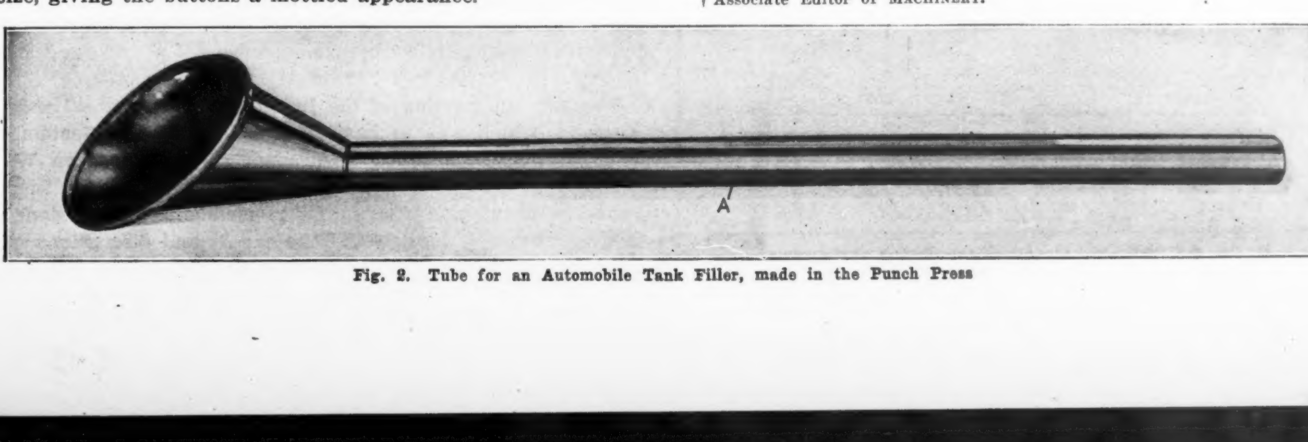


Fig. 2. Tube for an Automobile Tank Filler, made in the Punch Press

known as the die, is held to the ram of the press and carries two sliding jaws or blocks *B*. These are held to the face of the die-holder by strips *C*, provided with tongues which fit in grooves on the sliding jaws of the die. The sheet of metal, when being formed, is placed in the grooves *D* of the jaws, and as the press is tripped the die descends, bringing the strip into contact with the arbor *E*, and bending it into V-shape as shown at *D* in Fig. 3. As the ram of the press continues to descend, the beveled faces of blocks *F*, Fig. 4, come into contact with the beveled edges of the sliding dies *B*, forcing them in against the tension of the springs and bending the strip into tube form as shown at *E* in Fig. 3.

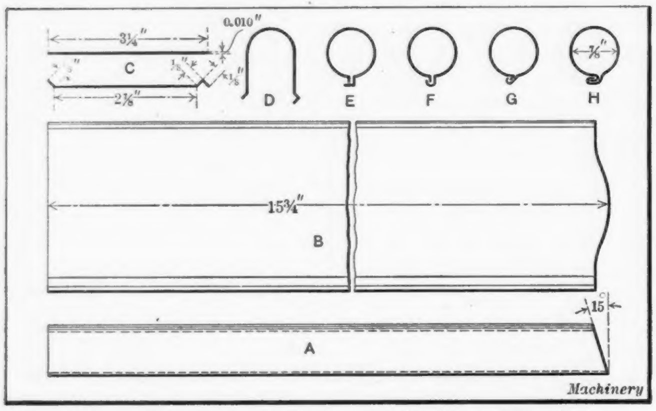


Fig. 3. Diagram showing Sequence of Bending and Forming Operations in producing the Tube in the Punch Press

Upon the continued downward movement of the ram the supports holding the arbor *E* recede, as they rest upon a spring pad located under the bolster, and the die-operating blocks *F* discontinue to act, so that the tube is confined between the circular faces of the dies, strip *G* and punch *H*, thus forming the tube into the shape shown at *F* in Fig. 3. Then as the ram of the press ascends, the tube is removed from the arbor by simply forcing down the post *I*, Fig. 1, which rests on the rubber pad, when the tube easily slips off the arbor.

All the working parts of both the die and punch are made from tool steel and the wearing parts are hardened. The last and final operation on this tube is the flattening of the seam. This is accomplished by a simple punch and die illustrated to the right in Fig. 5. The die in this case has a slight movement on the bed of the punch and is provided with two differently shaped projections. The formed tube is first placed so that the seam is located in one groove, and as the ram descends the projecting seam is bent over to an angle of 45 degrees, as shown at *G* in Fig. 3. The tube is then shifted to

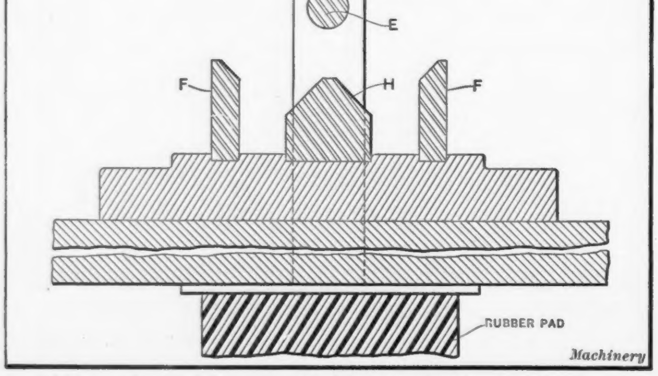


Fig. 4. Sectional Diagrammatic View showing Construction of Tube Forming Punches and Dies

the other groove and the seam flattened as shown at *H*. While the seaming operations are being accomplished, the tube is held on the arbor *C*, shown in the punch, Fig. 5. The finished tube is shown at *D* in this illustration. While the punches and dies shown in the illustrations appear to be comparatively simple in construction, it required considerable experimenting to produce this job, because of the great length in proportion to the small diameter. However, it was successfully accomplished and the tube is certainly a nice piece of work.

* * *

PUBLIC EMPLOYMENT OFFICES

The United States Commission on Industrial Relations, at Washington, has published a tentative plan of a national system of labor exchanges to cooperate with state and local public employment offices, and to regulate private employment agencies in interstate business. The proposed plan contains features drawn from the laws of various states and countries, and from correspondence with persons and organizations interested in this vital subject. Copies of the tentative proposals may be had by applying to the Commission on Industrial Relations, Southern Bldg., Washington, D. C., and it is requested by the commission that all persons having criticisms or suggestions to offer should submit them in writing to the commission. The proposed plans, as published, give details of the organization, defining the duties, powers and authority of the bureau and its method of carrying on its work. It also gives legislative rules relating to appli-

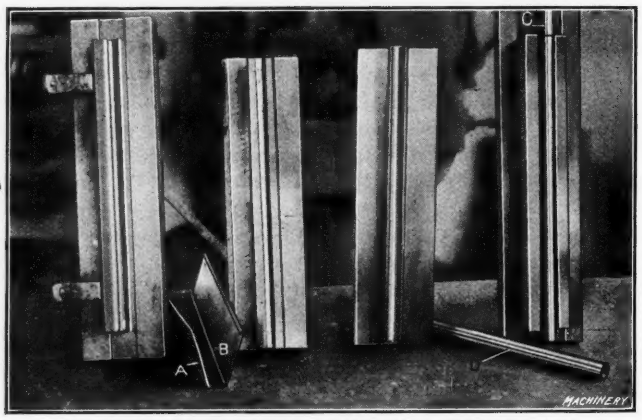


Fig. 5. Punches and Dies for bending Edges of Sheet and for flattening the Seam

cants and private employment agencies, fees, etc. The rules relating to the private employment offices are especially designed to prevent the frequent abuses which have sprung up in this business. All such employment agents are, according to the proposed plan, required to obtain a license, and the application for such license must be accompanied by a bond for a sum of $1000 as a guarantee that the applicant will conform to the rules and not violate any of the terms, conditions and requirements of the law. Licenses may be refused when the conditions set forth in the proposed plan warrant this, and they may also be revoked under certain conditions. Special rules are made with regard to the fees charged by these private employment agents.

Regulations are also contained for the management of the employment offices conducted by the bureau either directly or jointly with other authorities. It is expected that a great deal of interest will be taken in this matter, as it is of vital importance to employers as well as to employes that the employment agencies of the country be under more strict supervision and that their efficiency be increased through the supplementing of their services by a comprehensive system of national public employment offices.

* * *

The autumn meeting of the Iron & Steel Institute, London, England, which was to have been held in Paris, September 17-22, has been cancelled on account of the European War. The papers that were to be presented will be printed in advance as usual, and distributed to members. Discussion by correspondence is invited and the papers and discussions will be published in the next number of the *Journal*.

RAPID PISTON TURNING ON A DOUBLE-SPINDLE TURRET LATHE

One of the examples of rapid production turned out by the Jones & Lamson double-spindle turret lathe in the factory of the H. H. Franklin Mfg. Co., Syracuse, N. Y., is a piston finishing job. Fig. 1 shows the general character of this work and the way it is done; Fig. 2, the set-up on the turret lathe; and Figs. 3, 4, 5 and 6 the work done at each operation. The pistons are 3⅝ inches diameter and 5 inches long.

The pistons come to the turret lathe with the open end faced off ready to be held on the spindles of the lathe by

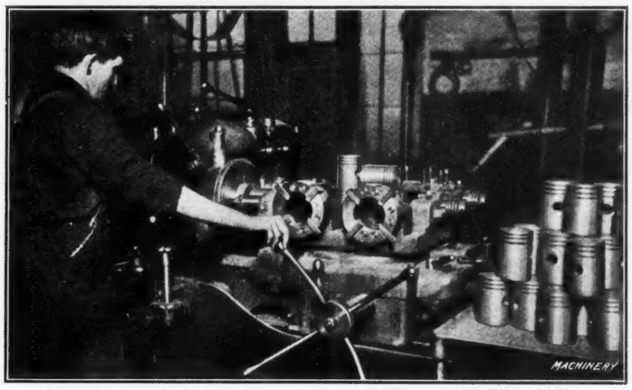


Fig. 1. Turning Pistons on a Jones & Lamson Double-spindle Flat Turret Lathe

connection through the wrist-pin holes, which have been drilled. After two pistons have been put in place on the machine, the outsides are rough-milled by the hollow-milling tools *A*, Fig. 3. These remove about 3/16 inch of metal, using for the purpose the four inserted high-speed steel cutters that may be seen in the line illustration and also in the general view, Fig. 1. The turret is now indexed, bringing the groove-roughing tools *B*, Fig. 4, into place. These in reality are circular forming tools having the groove-cutting sections spaced so that the three grooves are cut simultaneously and at the correct distance apart. The turret is indexed again, bringing the tools which may be seen in the foreground in Fig. 2 into play. These tools consist of the two pairs of tools *C* and *D*, Fig. 5; tools *C* start midway of the piston and tools *D* start at the front end, each turning half of the finishing cut for the diameter. This cut being taken, tools *E* are used in an inverted position for facing off the ends of the pistons to length. The last indexing of the tool turret is for the purpose of bringing the tools into play that are shown in use in Fig. 2. These are the finish-grooving tools which finish to size the ring grooves as well as the oil grooves. These tools are indicated at *F*, and at

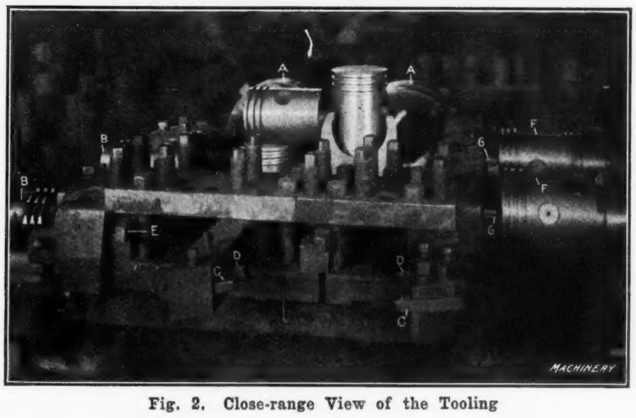


Fig. 2. Close-range View of the Tooling

G, Fig. 6, are the centering tools for centering the piston. The diameter is held to a limit of 0.002 inch and the length to 0.005 inch. The pistons are turned out at the rate of ninety in ten hours. C. L. L.

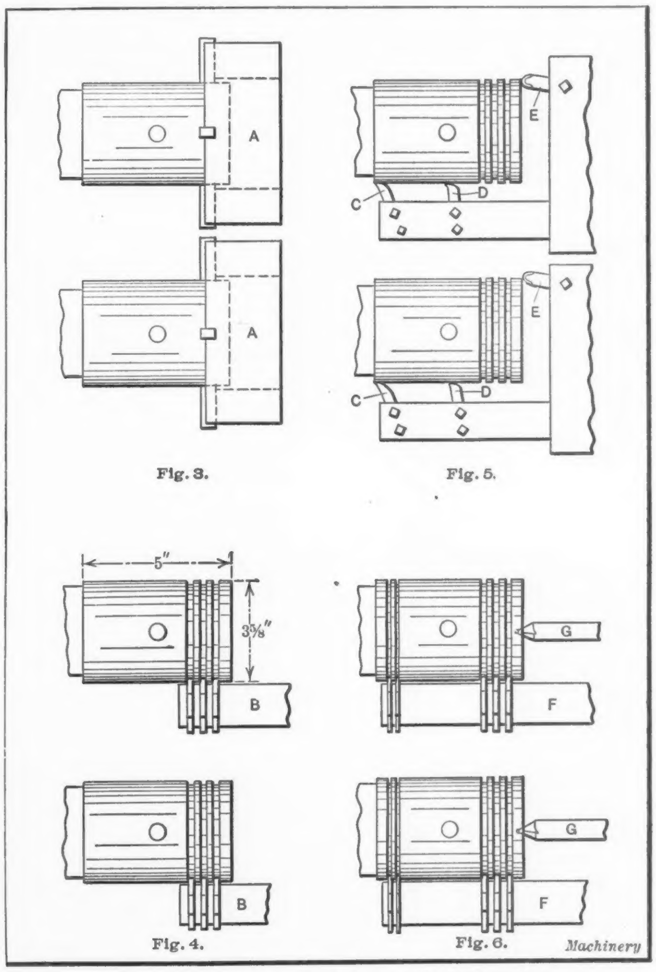
* * *

In a contemporary, we find the following paragraph: "In addition to other advantages offered, it is generally conceded that the hollow bar is stronger than the solid." Why not make them all hollow, then, and save the expense of metal altogether?

A MINE AT THE SAN FRANCISCO EXPOSITION

The United States Bureau of Mines has undertaken to construct, in cooperation with the mining industry and the manufacturers of mining machinery, a mine beneath the floor of the exposition building of mines and metallurgy at the San Francisco exposition. The entrance to the mine will be through the building and visitors will be attracted to it by being given portable mine lamps. They will then be lowered in a cage, while a panoramic effect of the strata lining the shaft will pass by them so rapidly as to produce the illusion of descending to a considerable depth. This method of producing the effect of a descent of several hundred feet when only lowering from one floor to the next was successfully employed at the exposition in Stockholm in 1897, where a mine exhibit similar to the one planned for the San Francisco exposition attracted great attention.

At the San Francisco Fair there will also be a motion picture room which visitors will pass in going from mine to mine, in which will be shown open workings which cannot be illustrated in the underground mines. Twice each day there will be an "explosion" or "fire" in some portion of the



Figs. 3, 4, 5 and 6. Work done at Each Operation

mine announced by telephone to the superintendent's office in the Bureau of Mines, on the "surface," and rescue men wearing breathing apparatus will enter the mines and bring out the "victims" who will be given first-aid treatment in an emergency hospital.

* * *

In a recent number of the *Daily Consular and Trade Reports*, Consul Samuel H. Shank, of Fiume, Hungary, strongly advises American exporters to take proper care of the foreign business coming their way. He states that many American firms are very slow as regards deliveries and that consuls who take pains to urge people to import American products are placed in a difficult position through the failure of the home firms to fill the orders in a reasonable time. This, says the consul, is no new story, but if it is often repeated it may eventually have the desired effect.

SPRING WINDING AND COILING*

VARIOUS METHODS OF WINDING AND COILING CONICAL, BARREL AND IRREGULAR SHAPED SPRINGS

BY DOUGLAS T. HAMILTON†

MANY ingenious methods and devices were employed for winding springs of irregular shapes prior to the invention of the now successful spring winding and coiling machines. Generally, the speed lathe was used for this work, with arbors of various types, as described in the following. It is a simple matter, of course, to wind a straight

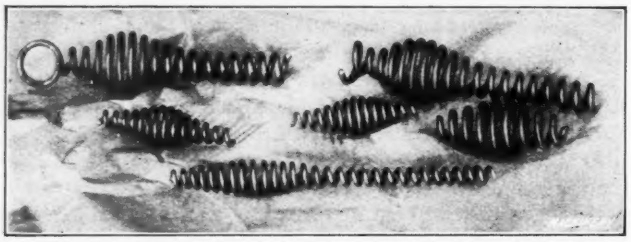


Fig. 1. Types of Irregular-shaped Springs wound on Arbors in the Lathe

spring from wire, but an entirely different proposition to wind springs of the shapes shown in Fig. 1. In this case it will be seen that the diameter of the spring varies from end to end, so that the ordinary method of winding cannot be employed.

Primitive Methods of Winding Irregular Shaped Springs

One of the first successful methods employed for winding irregular shaped springs of the type shown in Fig. 1 was to make an arbor as shown at *A* in Fig. 8. This was an ordinary arbor provided with a key-slot, around which babbitt metal was cast; the metal was faced off and held in place by a nut as illustrated. The babbitt was then turned to the shape of the spring desired, the spring wound around it, after which the babbitt was melted out to allow the spring to be removed. Of course this method was only employed where one or a few springs were desired, and would not have been satisfactory for winding a large number. The spring, when being wound, was guided on the arbor by the simple device illustrated in Fig. 4, which will be described later. It is possible to wind the spring on this arbor by cutting a helical groove of the pitch desired, but this presents considerable difficulty owing to the irregular shape of the arbor itself.

Another very simple but effective means of winding irregular shaped springs is by employing the arbor shown at *B* in Fig. 8. This is somewhat similar in construction to that shown at *A*, but instead of having a babbitt form, the form on which the spring is wound is composed of a series of washers. These washers are provided with key-slots before being put on the arbor and the latter is provided with a key to prevent the washers from turning. If a considerable number of springs is required, the washers are numbered consecutively so that they can be easily replaced in the proper order.

The outer contour of these washers is then machined to the required curve, and if the guide shown in Fig. 4 is not provided, a helical path is cut in the outer surface to serve as a guide for the wire. The spring is wound by starting from the left-hand end. After it has been completed, the nut is removed, the washers loosened up and the spring spread apart, allowing the washers to drop out between the convolutions of the wire. The washers are then assembled on the arbor in their proper order and are ready for action. The method just described is somewhat more satisfactory than that shown at *A* in Fig. 8, but it still leaves considerable to be desired when a large number of springs is to be wound. However, it must be admitted that considerable ingenuity was displayed in working up this simple but effective means of winding an irregular shaped spring.

A still more advanced and satisfactory means of winding irregular or barrel shaped springs on an arbor is illustrated at *C* in Fig. 8. To make this arbor a bar of stock large enough to be machined to the required size is centered on both ends and a cut is taken across it. Following this, a helical groove slightly greater in width than the diameter of the spring to be wound is cut from end to end, this groove having a circular bottom or root diameter, which of course must be smaller than the smallest diameter of the arbor. The next operation is to turn the contour of this arbor to the shape of the spring desired, after which it is ready for winding the spring.

To wind a spring on an arbor of this kind in the speed lathe, an attachment or device similar to that shown in Fig. 4 is necessary. This consists primarily of two brackets *A* which are fastened to the bed of the lathe; in the top of these is located a round guide bar *B*. Extending from the guide bar is an operating handle *C* which carries a guide *D*, the latter being held in place by a screw as illustrated. The handle must be a free sliding fit on the rod *B*. As a means for guiding the wire, the guide *D* is made in two forms as shown at *E* and *F*. The guide shown at *E* is used for guiding wire which is smaller in diameter than the width of the land on the arbor *C*, Fig. 8, whereas the guide shown at *F* is used for wire equal in width to the land on the arbor. By using a guide of this shape which straddles the projection on the arbor, it is unnecessary to cut grooves in the land of the arbor to guide the wire, as the guide serves the same purpose and is more effective.

Another type of irregular shaped spring and the arbor for winding it is shown in Fig. 5. This spring shown at *A* is generally used for wire handles in which the wire is rewound upon itself by using the arbor shown at *B*. This arbor, because of its shape, is held in a chuck when winding the spring. A groove *a*, as shown in the illustration, is cut practi-

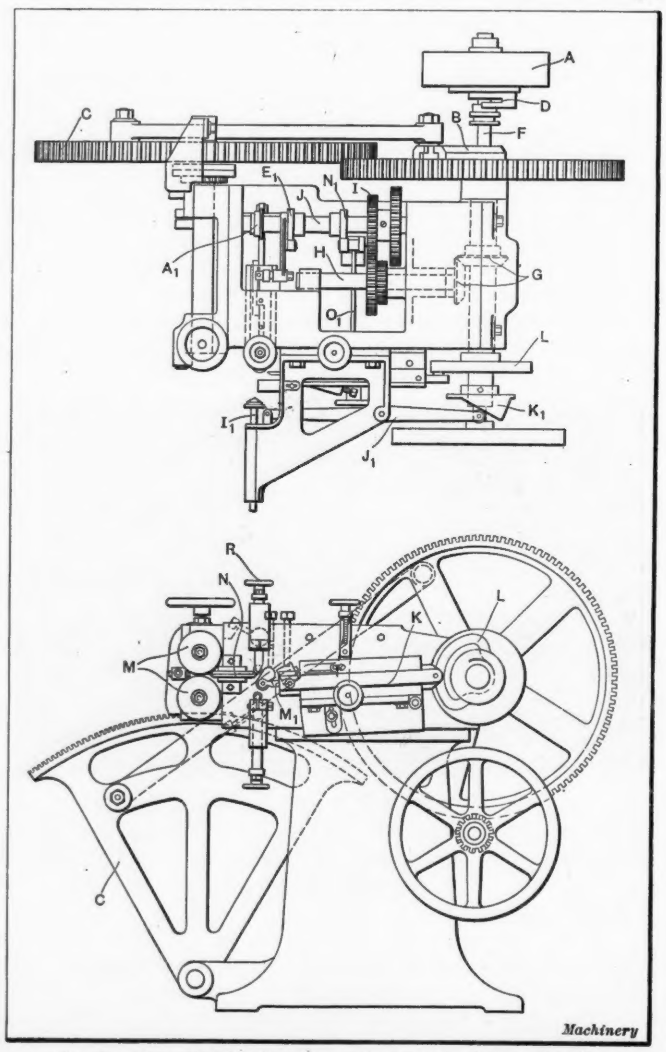


Fig. 2. Plan and Elevation Views of the Spring Coiling Machine shown in Fig. 7

* For additional information on spring winding, see article entitled "Winding Piano Wire Tension Springs" and Data Sheet Supplement published in the April, 1913, number of MACHINERY.
† Associate Editor of MACHINERY.

cally the full length of the arbor slightly past the center. The wire to be wound is then laid in this groove and twisted around, a helical guiding groove having previously been provided on the circumference of the arbor. The spring can also be wound by gearing up an engine lathe to give the desired pitch and using a guide held in the toolpost. When the wire has been wound completely along the arbor and onto the part of the wire that is extending from the groove, the spring is removed by simply pulling it off. This is easily accomplished, as the largest diameter of the arbor is next to the chuck.

*The terms spring winding and coiling in general trade usage denote two entirely distinct processes. In winding, the machine grips the wire and holds it firmly against the center arbor. The wire then commences to turn around the arbor as when winding in a lathe. The diameter of the spring in this case is determined by the size of the arbor and the tension given it while winding. In coiling springs, however, the action is entirely different. The wire is first forced into a circle by rolls or tools acting on the outside of the wire, and the forming of the spring does not depend entirely, in fact little at all, on the center arbor; in other words, the center arbor does not have to be of the same inside diameter as the coil of the spring to be wound. The following description applies only to the producing of springs by coiling, and covers two different types of machines used for this purpose.

The Hoefer Spring Coiling Machine

The spring coiling machine, plan and side elevation of which are shown in Fig. 3, was designed and patented by F. W. and A. G. Hoefer, of Freeport, Ill., in 1898. It comprises a mechanism for intermittently feeding the wire from a coil, a device for decreasing or increasing the pitch of the spring and a device for deflecting the wire from its normal path so as to form it into a spring of the desired shape. It also comprises a varying device for operating the deflector so that tapered, irregular or springs of any desired shape can be wound; in addition there is also a device for severing the wire when a spring has been completed.

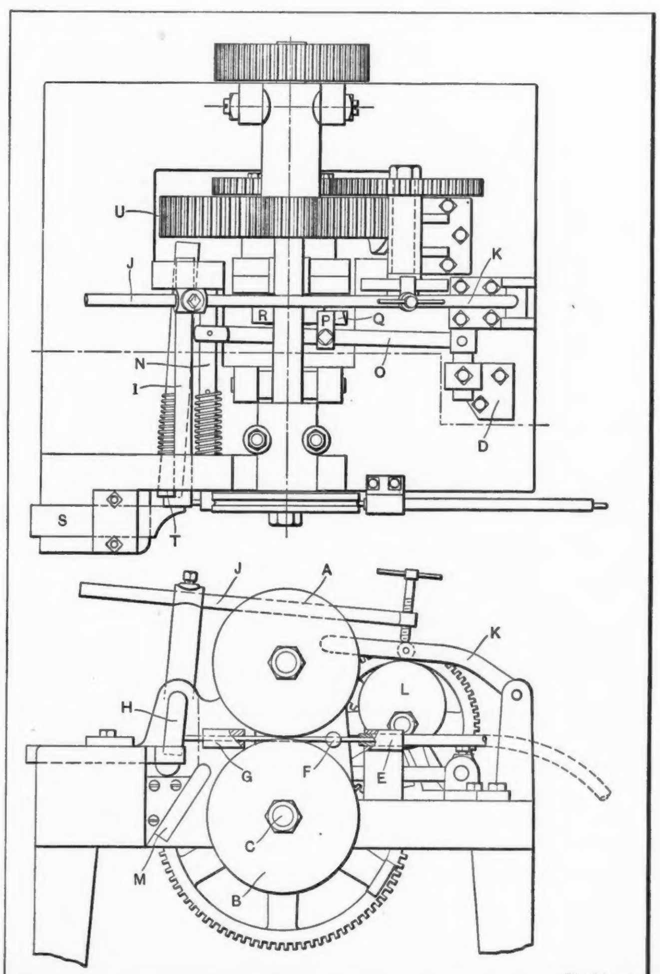


Fig. 3. Spring Coiling Machine patented in 1898 by F. W. and A. G. Hoefer

The wire is fed to the coiling devices by two grooved rolls A and B. The lower feed roll B is mounted on the stationary main shaft C of the machine, whereas the upper roll A is mounted on another shaft located above the main shaft and driven by gearing from it. The upper shaft is susceptible of oscillation so that it can be raised sufficiently to clear the feed roll B and thus interrupt the feeding of the wire. This movement is effected by means of a lever and roll which is operated by means of two cams mounted loosely on the main shaft and rotating independently of the shaft. The periphery of each of these cams is of varying radius and a portion is so made that it raises the roll sufficiently to depress the front end of the shaft and thus give a feeding movement to the

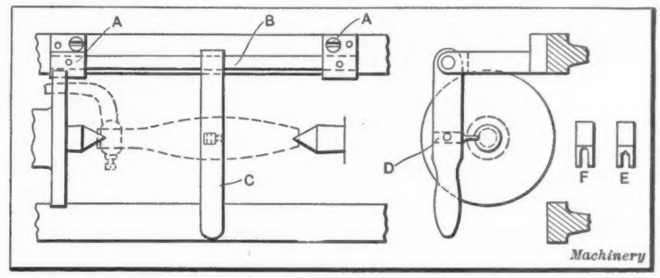


Fig. 4. Dividing or Spacing Devices used in winding Irregular-shaped Springs in the Lathe

wire. The remainder of the periphery of the cam is cut away, allowing the upper roll to release its grip on the wire and stop the feeding action. The two shafts carrying the rolls are geared in the correct ratio and in connection with the cams give the proper feeding movement to the machine.

The wire is conducted to the feeding rolls by means of two guides E and F, and after it leaves the rolls it is guided by a bushing G. As the wire leaves guide G it strikes a deflector H formed on the front end of the shaft I. This shaft is mounted in supports in the frame of the machine and is free to oscillate, so that its distance from the guide G can be varied at will; this is controlled by means of a cam as will be described later. The distance of the deflector from the front of guide G governs the diameter of the spring.

In order to give shaft I the desired amount of oscillation, it is provided with an extended arm, as shown in the lower view, in which a rod J is held. This rod carries on its opposite end an adjustable set-screw which bears on a lever K. Lever K is fulcrumed in a bracket on the machine and carries a roll that operates on cam L, the latter being formed to the correct shape to give the required movement to the deflector H. Of course for different types of springs, it is necessary to have cams of various shapes.

The spacing of the coils of the spring is effected by means of a spacer M which comprises the bent end of the rod N. Rod N is attached to lever O which is pivoted to a post that is adjustable in the bracket D; bracket D is adjustably held to the bed of the machine. Rod O carries a dog P which contacts with a cam lug Q that is a member of cam R on the main driving shaft. The spacer is held normally out of the operating position by means of a coil spring as illustrated. The lug on cam R is of such a length that it holds the spacing bar out long enough to complete one cycle of the machine or whatever portion of a cycle is required to complete the spring.

The cut-off arrangement consists of two knives S and T. Knife S is held in a groove in the machine base by a clamp as illustrated; knife T is adjustable in a groove in the machine bed and is kept in its backward position by means of a coil spring as illustrated. Knife T comprises a rod, against the rear end of which a cam on gear U comes in contact. This forces the knife out at the proper moment and severs the wire which lies against the cutting knife S. The various mechanisms of the machine are driven by gearing as illustrated, which, of course, is connected to a main driving shaft, operated from the overhead works by means of belting in the usual manner. The machine is automatic in operation and is generally fitted up so that one revolution of the large driving gear U completes the spring. All the various operating mechanisms that control the length and diameter of the spring are adjustable so that various lengths, diameters and shapes can be produced.

Other Machines for Coiling Irregular-shaped Springs

The preceding methods of winding irregular-shaped springs are only applicable to the making of a small number of springs, and could not be used satisfactorily for making springs commercially. Several interesting spring coiling machines, in addition to the Hoefer machine already described, have been developed for this work, but as they incorporate somewhat similar principles it has been thought advisable to describe only one of the latest types of spring coiling machines, two sizes of which are shown in Figs. 6 and 7. These machines are designed on the same principle, and are built by the Baird Machine Co., Bridgeport, Conn. Essentially, this machine consists of a means for controlling the diameter and pitch of the spring when coiling, and a cut-off mechanism for cutting off the wire to any desired length.

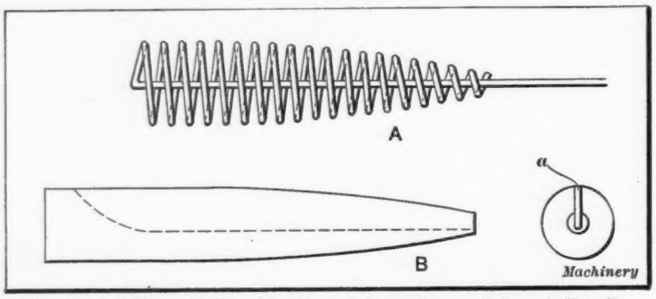


Fig. 5. One Type of Wire Handle and the Arbor used for winding it. Note how Wire is wound upon itself

General Construction of Spring Coiling Machines

Power for actuating the various movements of the machines shown in Figs. 6 and 7 is secured through a main driving pulley *A* which receives power from an overhead shaft. This pulley drives the eccentric plate *B* through a pinion and large gear as illustrated, and the latter is connected by a link to the segment gear *C*, which controls the feeding mechanism. The machine is stopped and started by means of a clutch *D* which is operated by the handle *E* shown in Fig. 7. The main driving shaft *F*, Fig. 2, through a pair of bevel gears *G*, drives an intermediate shaft *H*, which, through sliding gears *I*, operates the cam-shaft *J*, two speeds being secured. From this intermediate and main shaft the various feeding, diameter-controlling and cutting-off mechanisms are operated.

The Feeding Mechanism

The wire is fed into the machine by a pair of feeding rolls *M* which are held in a bracket and carried by shafts geared together. The lower shaft carries a ratchet wheel which is engaged by pawls carried by a disk, the latter being made integral with a pinion meshing with the segment gear *C*. From the main shaft power is transmitted through the segment gear and the mechanism outlined to the feeding rolls. The wire passes from the feeding rolls *M* to a guide *N* extending from the cap plates and goes directly from the guide to the coiling rolls or coiling tools that control the diameter, as will be described later.

The length of the wire for each spring is varied by changing the position of the link on the eccentric plate *B*. This link is connected to the plate by a stud that turns freely in the link and is provided with a T-head engaging with a corresponding groove in the plate. Changing the position of the link in relation to the axis of the plate determines the amount of oscillation of the segment gear *C*, and consequently the length of wire drawn in by the feeding rolls; adjusting the stud to the extremity of its outward movement produces the maximum length of wire that can be fed in at one revolution of the plate.

The operation of the feeding mechanism is as follows: When the segment gear *C* is moved toward the left, the pawls engage with the ratchet and impart a rotary movement to the pinion held on the lower feed roll shaft, and as both shafts are geared together, both rolls are rotated. Then when the segment gear is moved toward the right, the pawls slip over the teeth of the ratchet, thus imparting no rotary movement to the rolls. In order to prevent the possibility of the feeding rolls continuing to move forward by momentum after the forward movement of the segment gear has stopped, when the machine is working on light wire, and also to prevent any backward movement through the reaction of heavy wire, a friction device on the lower feed roll shaft is provided. This consists of clamping arms enclosing the feed roll shaft, which are drawn together by a set-screw, being kept from rotating with the shaft by a pin passing between them, engaging with a lug on the cap plate.

The Diameter Control

The diameter control, which is one of the most interesting features of this spring coiling machine, is shown in detail in Fig. 9. As the wire comes from the guide it strikes a roll *O*, and is deflected to the roll *P*; it is then picked up again by the roll *Q*. By this time the wire has been formed into circular shape. The coiling roll *O* is carried by a slide which can be moved longitudinally in a holder having a shank fitting in a socket which is held in place in the machine by a set-screw. The slide carrying the coiling roll is adjusted longitudinally in the holder by means of a screw attached to the operating handwheel *R*, Fig. 2.

It will be obvious that the coiling rolls or tools, no matter whether one or three are used, must each be adjusted in the proper relation to each other or to the arbor. To start with, there are three possible adjustments of the coiling roll *O*. The first is for diameter control, and is secured by adjusting the roll holder up or down in the slide; the second is for maintaining a certain relation between the center of the coils and the coiling roll, and this is obtained by rotating the holder *S* on the shank *T*; the third is for controlling the pitch of the spring, which will be described later.

Cam Control of the Coiling Roll

The adjustments previously described have to do only with the use of the coiling roll for making straight springs. In order to provide for making cone, barrel and other irregular-shaped springs in which the coils progressively increase or diminish in diameter, an automatic arrangement for varying the diameter of the coils is incorporated. This mechanism is operated from the cam A_1 on shaft *J*, Fig. 2, which it will be understood, has to be changed for each different type of spring that is to be wound. If, however, only the length or diameter is changed and not the shape, this same cam can be used by making the necessary adjustments previously described.

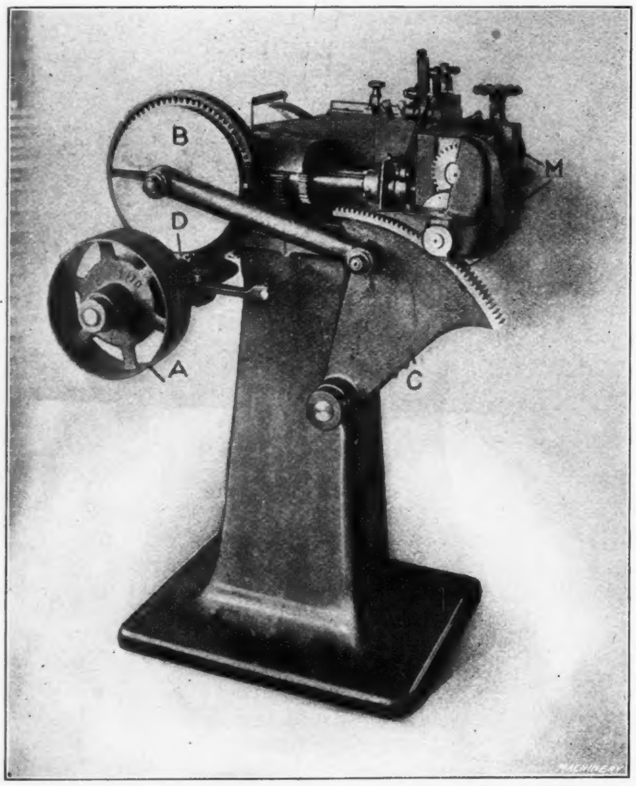


Fig. 6. Rear View of One of the Later Types of Spring Coiling Machines built and patented by the Baird Machine Co., Bridgeport, Conn.

In order to facilitate the removal and insertion of these cams they are made in halves (see Fig. 10), each part being supplied with a slot to receive a cap-screw that engages a

collar rigidly secured to the shaft. In the making of barrel, cone and similar shaped springs, in order to permit free reciprocation of the slide carrying the rolls, the cap-screws must be loosened. This leaves the slides free to be controlled in their movement by connecting links and a bellcrank lever. One arm of the bellcrank lever carries a roll which engages with the periphery of the cam, whereas the other is adapted to engage in the slides. The adjustment of stud B_1 in the slot in the bellcrank lever C_1, Fig. 10, enables various sizes and lengths of cone and barrel springs to be wound; this also allows the use of different sizes of wire without changing the cam A_1, provided of course the style of spring is not changed. To change from winding left- to right-hand springs, the position of the rolls O and Q, Fig. 9, must be reversed from that shown by the full lines in Fig. 9, where a left-hand spring is being wound. To wind a right-hand spring the wire first contacts with roll Q and is deflected upward as shown by the dotted lines.

Pitch Control Mechanism

The pitch control mechanism is that part of the machine which regulates the distance in a longitudinal direction between the separate coils of the spring. This is effected by means of a pusher D_1, which reciprocates freely in the hole in the framework of the machine, and passes through a guide plate to preserve its proper alignment. The pusher is actuated from cam E_1 on shaft J, see Fig. 11. This cam engages with a roll F_1 carried by arm G_1, which is provided with a yoke at its inner end that fits over shaft J to hold the arm in position. The outer end of the arm is provided with a stud which is adjustable in a slot in the arm H_1 to increase or diminish the throw of the pusher. It will be noted that the operating face of the pusher D_1 is made convex in order to reduce the bearing surface on the wire.

In practice, the pusher is made broad enough to enable it to act upon the coils of varying diameter, and is changed when required. Adjustment of the outer end of the arm G_1 in the slot determines the amount that the coils are separated from each other, it being understood, of course, that the pusher

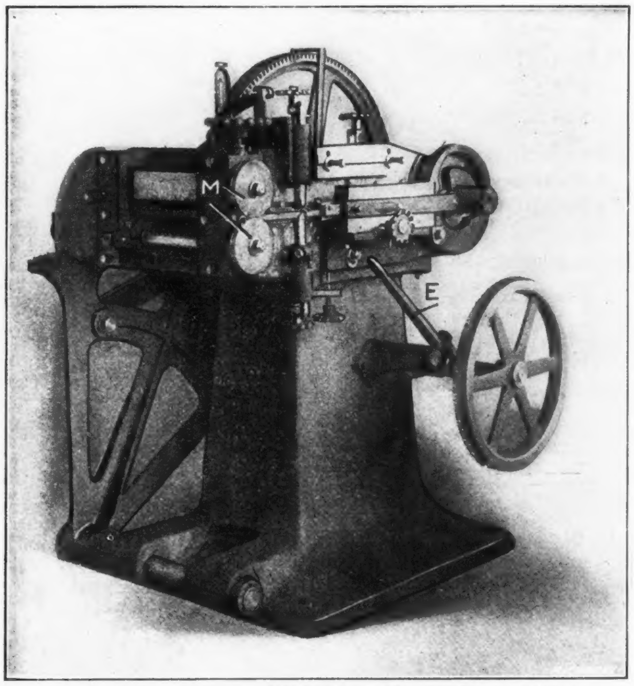


Fig. 7. Front View of Baird Spring Coiling Machine similar in Construction to that shown in Fig. 3 but of Larger Capacity

bears upon the coil already formed and imparts a permanent bend to the wire, thus separating the coil against which it bears the required amount from the coil being formed. A change of cams E_1 is required for various types of springs, and these must be laid out accurately to produce the desired result. This mechanism, however, is adjustable, so that with the same cam quite a variety of springs can be made. It is only when a different type of spring is wanted that a change in the cam is required.

The Setting Mechanism

It is understood in the manufacture of all compression springs for accurate work that the springs are formed to a greater length than normal and therefore require to be "set," as the operation is termed, before they are ready for use: that is to say, the spring must receive what is termed an "initial set" or compression. This operation is ordinarily performed independently of the making of the spring in an arbor press. In this machine the set is accomplished before the spring is cut off. I_1, Fig. 2, shows the setting plunger which is made to reciprocate in a bracket, the latter being adjustable in the framework of the machine. The plunger

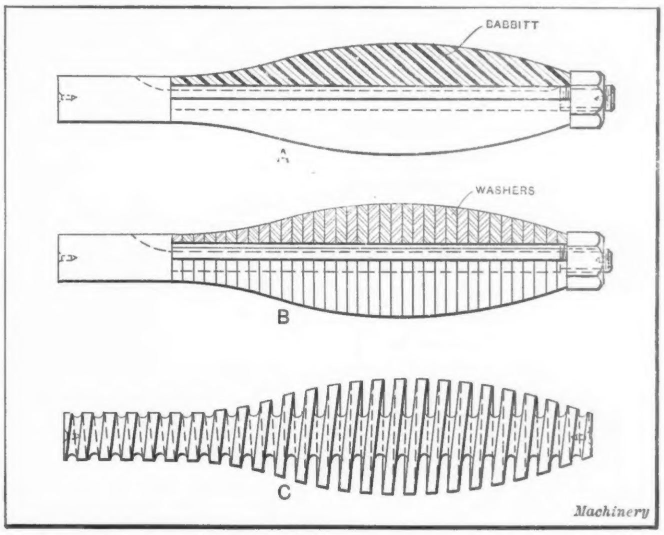


Fig. 8. Various Types of Arbors used for winding Irregular-shaped Springs in the Lathe

is provided with a detachable head which is suitably shaped to pass within, and also to support circumferentially the outer coil of the spring, and is changed when required. The plunger is reciprocated by means of a lever J_1 which is pivoted to the bracket and is provided at one end with a roll that engages with the face cam K_1 on the shaft F. To provide for adjustment, the plunger I_1 carries a clamp to which a connecting link is fastened, this, in turn, being fastened to the lever J_1. To facilitate changing from large to small, right- and left-hand springs, a plate is interposed between the base of the bracket and the framework, which secures both brackets and plate to the frame by cap-screws.

During the setting operation the attached end of the spring is supported by the coiling rolls, and it should therefore be understood that after the formation of each spring the feeding mechanism stops at the instant the setting operation takes place, after which the cut-off mechanism acts. As there is always more or less tendency for the spring to buckle in the setting operation, varying of course with the style and length of the spring, the bracket carrying the plunger is adjusted so as to place the axis of the plunger in proper alignment with the spring being operated upon. This should bring the axial line of the plunger parallel with, but slightly outside the axial line of the spring, which has the effect of making it impossible for the spring to buckle outward when subjected to the action of the setting plunger, and of giving it the tendency to buckle inward. To take the inward thrust, a plate is provided which partly encloses the spring and is adjustably secured to the bracket by means of a cap-screw.

The Cut-off Mechanism

The cut-off tool M_1 is adjustably secured to a slide K, Fig. 2, which reciprocates in a bracket. The slide is dovetailed into the bracket in which it slides and is provided with adjustable gibs to compensate for wear. At the rear end is a roll which engages with a groove in cam L located on shaft F, which actuates the movement of the cut-off slide. The cut-off die lies within the coils that are being made and acts with the cut-off tool in severing the wire. The shank of this die can be adjusted axially in order to place the cutting edge in the proper relation to the cut-off tool. The cut-off tool may be adjusted longitudinally with relation to the slide by means of a screw and pin which bears against the rear of the tool.

The Cut-off Control

The cut-off control is the mechanism which is brought into

use in making some cone springs, and also in making some special irregular shaped springs requiring an amount of wire in excess of the nominal maximum length for which the machine is adapted. Certain types of cone springs are more easily made in the form of double cones, and the cutting-off operation is performed alternately at the large end of the two springs and at the small end of the two springs, or in other words the springs are formed alternately with the large and small end first. This necessitates a cutting-off operation to separate the large end of the two springs, followed by a cutting-off operation to separate the small ends of the two springs.

To illustrate the use of this cut-off control, supose it to be operating on a spring flattened at one end only and having, say, twice the maximum normal length for which the machine is adapted. In this way, all the flattening of the two springs would be done at one place; that is, if the spring required two end coils flattened, then the pitch changing cam could be arranged to coil the four ends or four coils close together. The cut-off would take place alternately in the center of these four closed coils, and of course in the center of the open coil, thus giving springs flattened at one end only.

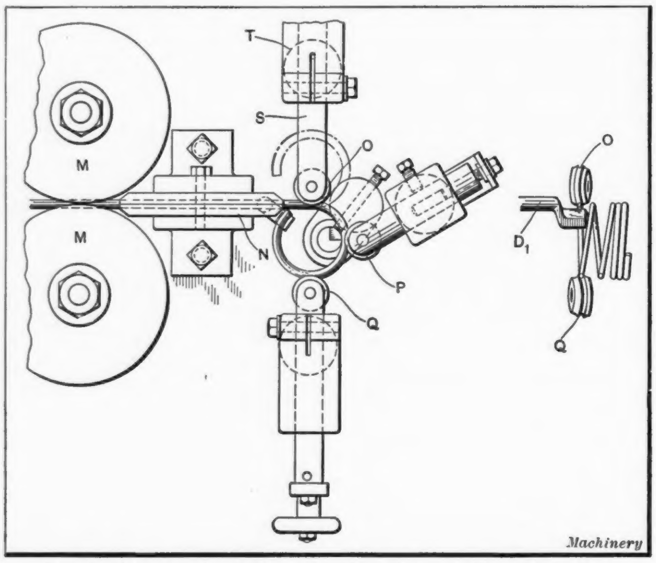


Fig. 9. Diagram illustrating Operation of the Coiling Mechanism

In both of the cases illustrated, it may be found that the position of the wire would not be entirely in front of the cutting knife when the time occurred to cut off, and that it may be necessary to move the cut-off knife a little in order to line up with the work. This is where the cut-off control comes into play, which changes the position of the holder or bracket that carries the slide and cut-off tool, the change being made automatically. To do this, the screws fastening the bracket in which the slide operates are loosened sufficiently to leave the bracket free to move laterally. The automatic movement of the holder is produced by means of cam N_1, Fig. 2, which engages with a roll held on an arm pivoted in a bracket, the latter being secured to the framework of the machine. This arm carries the controlling rod O_1, which passes through the framework to operate the cutting-off slide bracket.

* * *

Think out your work and work out your thoughts.

CRANKSHAFT FOR TWO-CYCLE INTERNAL COMBUSTION ENGINES*

BY D. O. BARRETT†

In the April, 1910, number of MACHINERY, the writer presented some formulas for crankshafts, applying to the four-cycle engine. Since that time, another engine has appeared on the market, the success of which is unquestioned, and which is rapidly replacing many of the engines using gasoline as a fuel. This is the two-stroke cycle oil engine. The formulas presented in the following will, of course, be equally applicable to the two-stroke cycle gas engine. The two-stroke cycle engine, having a power stroke for every revolution, is much smoother running than the four-cycle engine and produces more power for the same piston displacement. The production of power, however, is not double that of the four-cycle engine having the same cylinder dimensions, because the effective stroke is less than the actual stroke on account of the length of the ports in the cylinder wall. The scavenging is not as perfect as in the four-cycle engine where two extra strokes are employed to exhaust the burned gases and draw in a fresh charge.

Oil engines are liable to preignitions and excessive internal pressures and must, therefore, have crankshafts of ample size to withstand the stresses imposed upon them. The following formulas are derived from actual practice and are based upon the results of an investigation into this particular field for a firm building this style of engine.

The general crankshaft formula has the following form:

$$\frac{B^2S}{2\,D^3} = C \qquad (1)$$

B = bore of cylinder in inches;
S = stroke of piston in inches;
D = diameter of crankshaft in inches;
C = a constant.

This formula is based on the fact that the force of the

* See also MACHINERY, April, 1910, "The Calculation of Crankshafts for Internal Combustion Engines," and MACHINERY's Reference Book No. 65, "Formulas and Data for Gas Engine Design," Chapter III, "Crankshafts for Internal Combustion Engines."

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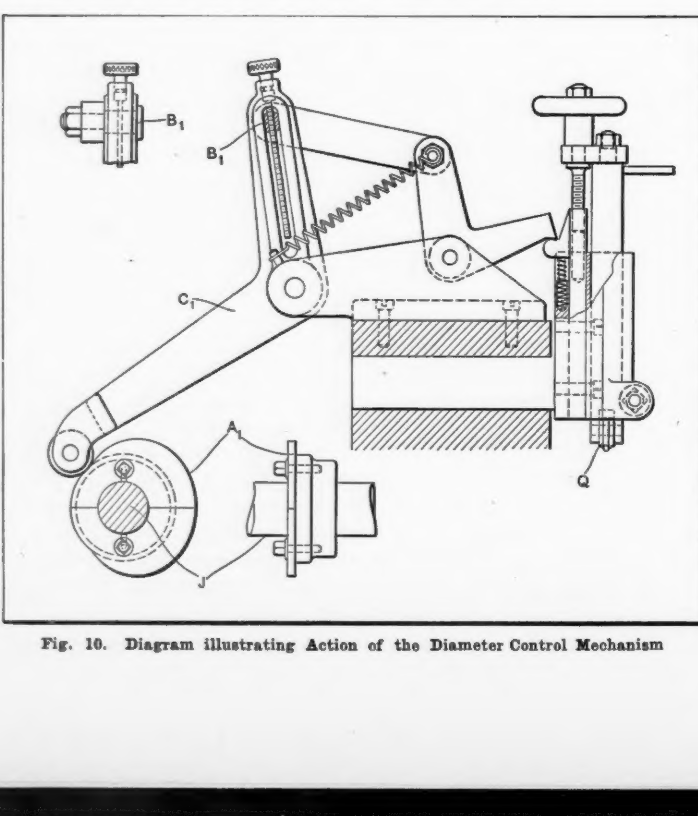

Fig. 10. Diagram illustrating Action of the Diameter Control Mechanism

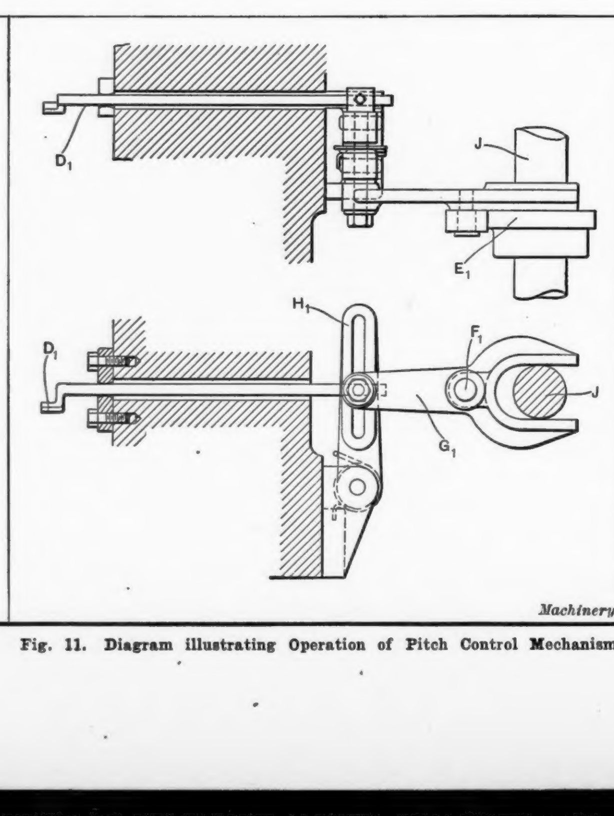

Fig. 11. Diagram illustrating Operation of Pitch Control Mechanism

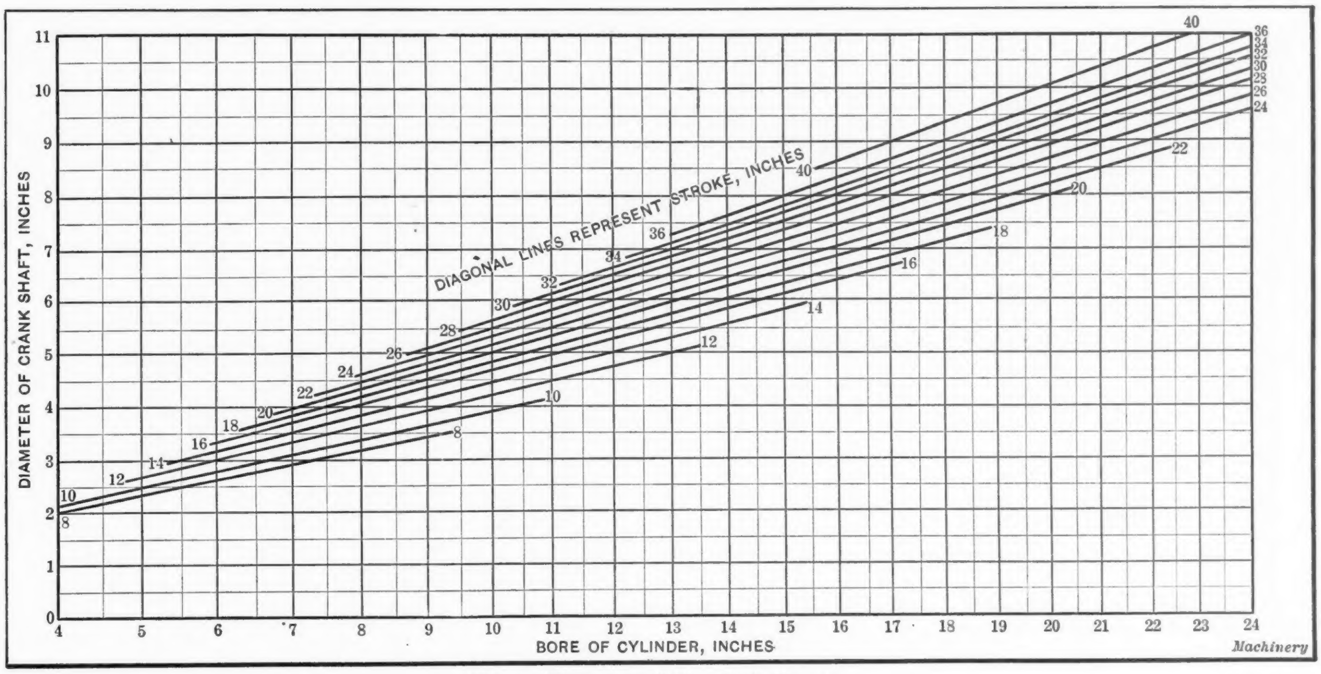

Fig. 1. Diagram for finding Shaft Diameter

explosion is proportional to the square of the bore, while the lever arm about which the force acts is equal to one-half the stroke. The resisting moment of the shaft is proportional to the cube of the diameter. Formula (1) may be reduced to the form:

$$D = \sqrt[3]{\frac{B^2 S}{2\,C}}. \qquad (2)$$

The value of the constant in Equation (1) was determined from a large number of existing crankshafts as equal to 8. This was found to be an average representative value. By substituting this in Equation (2) and simplifying the expression, we have:

$$D = 0.4 \sqrt[3]{B^2 S}. \qquad (3)$$

Now, the stroke is usually expressed in terms of the bore, so that we may say that $S = a \times B$; then:

$$D = 0.4\, B \sqrt[3]{a}. \qquad (4)$$

Then, if $x = 0.4 \sqrt[3]{a}$, we have $D = xB$.

The accompanying table shows the values of x for different values of a for various proportions of stroke to bore.

Fig. 1 shows a diagram by which the shaft diameter may be found directly without calculation. Locate the bore on the lower horizontal line, then follow a vertical line upward to the diagonal line representing the stroke, and from there follow a horizontal line to the left of the diagram where the diameter of the crankshaft is found. For example, an engine having a 12-inch bore and 18-inch stroke should have a shaft diameter of 5½ inches.

The length of the main bearings should be about twice the diameter of the shaft. The diameter of the crankpin is usually made about 1⅛ times the diameter of the shaft. The length of the pin may be less than its diameter and may be obtained from the formula:

$$L = \frac{0.22\, B^2}{d} \qquad (5)$$

in which

L = length of pin in inches;
B = bore of cylinder in inches;
d = diameter of pin in inches.

If Equation (5) gives a low value, the length of the pin is usually made practically equal to the diameter.

Crank Webs

The crank webs must not only be heavy enough to act as beams, in themselves, but must also be large enough so that the crank, when considered as a beam from end to end, will have a minimum distortion. When cranks are weak in this respect, the distortion is noted in the irregular motion or

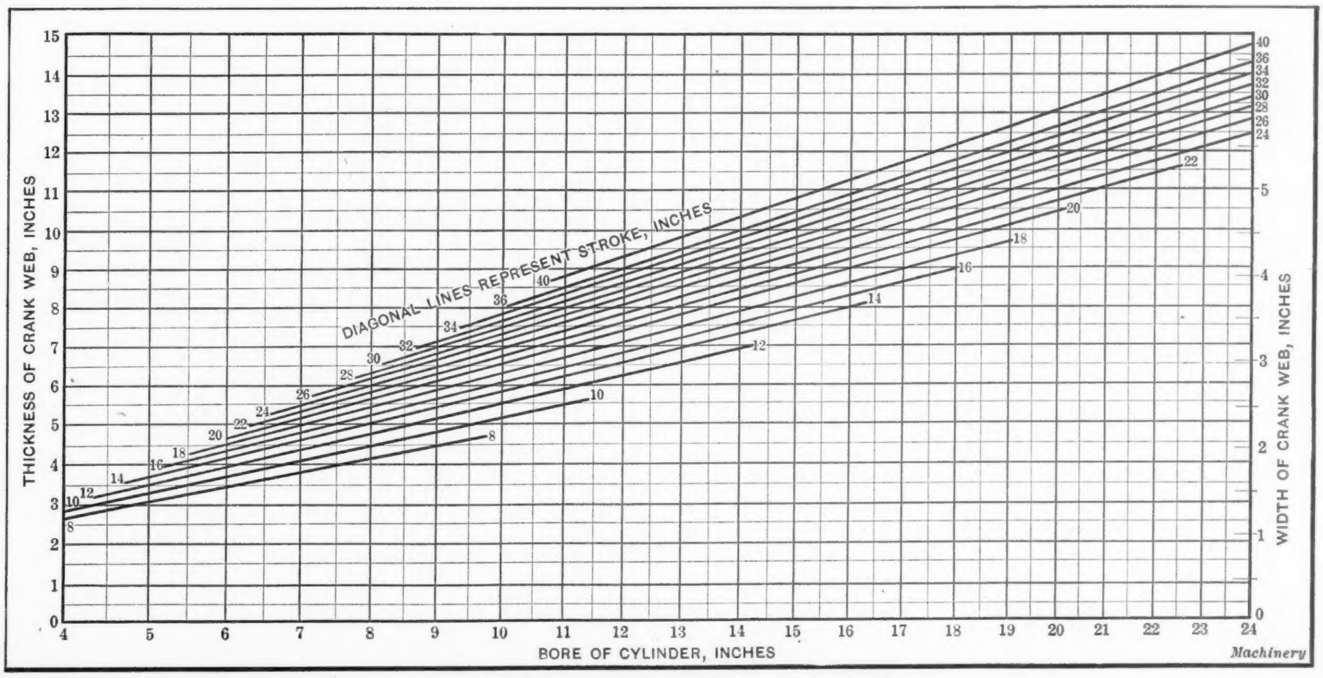

Fig. 2. Diagram for finding Dimensions of Crank Web

wobbling of the flywheels, and this is the cause of the breakage of many flywheels and shafts. Many cranks have webs thick enough in the direction of rotation, but too narrow in width. The ratio of thickness to width of web should be at least 2.2. The following equations for the crank-web dimensions give suitable proportions:

TABLE OF FACTORS x FOR VARIOUS VALUES OF a

a	x	a	x	a	x
0.9	0.386	1.2	0.425	1.5	0.458
1.0	0.400	1.3	0.436	1.6	0.468
1.1	0.413	1.4	0.448	1.7	0.477

Machinery

$$t = 0.52 \sqrt[3]{B^2 S} \quad (6)$$

$$b = \frac{t}{2.2} \quad (7)$$

in which

t = thickness of web in inches;
B = bore of cylinder in inches;
S = stroke of piston in inches;
b = width of web in inches.

The thickness of the web may also be expressed in terms of crankshaft diameter, since both are functions of the bore and stroke:

$$t = 1.3\,D. \quad (8)$$

Fig. 2 shows a diagram for finding the dimensions of the web. It is used in the same manner as the one for the crankshaft diameters. After having followed the vertical line from the bore to the diagonal line for the stroke, the thickness of the web is found to the left of the diagram and the width to the right. For example, for an engine of 12-inch bore, 18-inch stroke, the thickness of the web would be about 7⅛ inches and the width 3¼ inches.

* * *

MULTIPLE SLOT MILLING ATTACHMENT

An interesting attachment for milling T-slots in milling machine tables is used in the plant of the Rockford Milling Machine Co., Rockford, Ill. By the use of this attachment it is possible to complete the milling of the T-slots in one traverse of the table. Referring to Fig. 1, which shows a

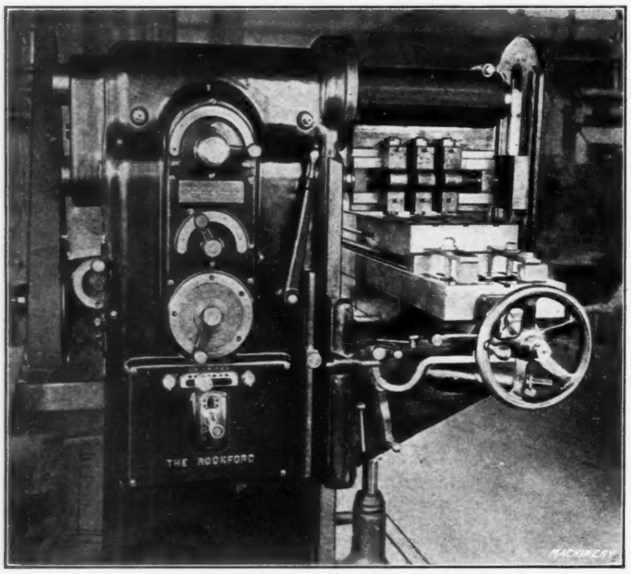

Fig. 1. Attachment fitted to a Rockford Milling Machine for milling Three T-slots at One Setting

general view of the machine and attachment, it can be seen that this attachment carries three heads for holding the milling cutters, the latter being driven by a long helical gear meshing with bronze helical gears on the vertical milling spindles. The three milling heads are adjustable along the base of the attachment and are held in the desired position by clamping blocks and screws. There are three different positions of the slots in the various sizes of tables produced by this company, so the heads have three corresponding positions, and to locate them tapered pins are put in from the rear, fitting in the head, and are then, of course, clamped in position by means of the screws which bind on a tapered wedge.

In preparing the milling machine table for T-slotting, the three slots are first milled with a set of gang cutters, leaving about 1/16 inch on the side of the slot for finishing. The milling table is then taken to the machine shown in Fig. 1, where the T-slots are finished. The guiding portions of the slots are finally finished on a planer, which has been found to be the most accurate way of doing this work.

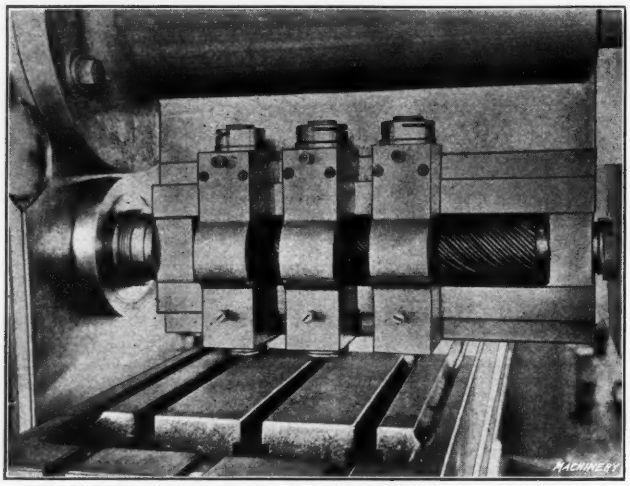

Fig. 2. Close View showing the T-slot Cutters and Attachment

The fixture itself is carried on the over-arm of the machine and is bolted to the flange of the column. It is also additionally supported from the knee by the bearing block shown, which is bronze bushed and is clamped to the supporting arm brace. This arrangement forms a very rigid support for the cutter-head, and enables the T-slots to be completed in one cut. On this particular table, which is 42 inches long, the T-slot is 1 inch wide and ½ inch deep. The actual time to cut three of these slots is fourteen minutes.

The end-milling cutters are provided with No. 7 Brown & Sharpe taper shanks, and are ground on the end after the taper has been ground so that all cutters stand out the same distance. The work is clamped to the table by means of V-blocks fitting on the under side of the table, and is located by a V-plate which fits over the vees of the under side of the milling machine table and is provided on its under surface with a tongue fitting in the T-slot on the regular table. This keeps the table parallel with the traverse of the milling machine table upon which the work is accomplished.

D. T. H.

* * *

Forged manganese bronze worms run with steel planer table racks and are used notwithstanding the comparatively high cost of the bronze. While the cost of the bronze is much higher than casehardened machinery steel, both as regards the rough forging—it being 28 to 30 cents a pound—and the labor of cutting, the final result is found superior by one machine tool builder who has tried both. He has been unable to caseharden large worms without distorting the threads and the walls of the hole. Grinding, of course, would correct the inequalities but it would remove most of the hard case and would be an expensive process. It is found cheaper to use a high-priced manganese bronze.

* * *

Tests made in France and reported in *Le Genie Civil* indicate that when holes are drilled and then reamed in soft steel, the metal between the holes increases on an average of nine per cent in its ultimate strength and twelve per cent in its elastic limit. This condition is explained as being due to the fact that the metal is compressed and thus offers a higher tensile resistance to rupture. Hence, if several holes are drilled, so as not to injure the material as in punching, the average tensile strength of the section across the holes per unit area of metal will be higher than before the holes were drilled.

DEVICES FOR PROTECTING MACHINE TOOL BEARINGS

METHODS OF EXCLUDING CHIPS AND GRIT, AND AVOIDING BRUISES CAUSED BY DROPPING TOOLS

BY JOSEPH HORNER*

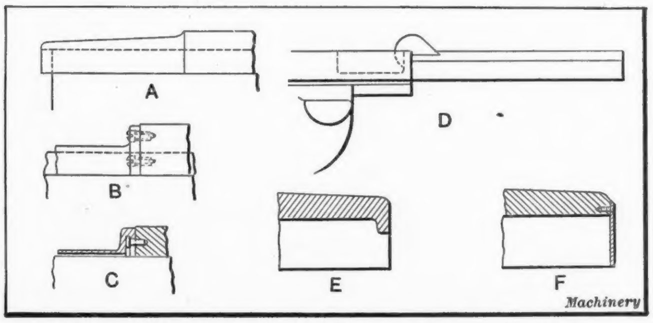

Fig. 1. Devices for protecting Slides of Lathes and Grinders

THE protection of the sliding and running parts of machine tools is a subject to which more and more attention is being paid. The legitimate wear of rubbing surfaces when supplied with a film of lubricant, takes place at an extremely slow rate; but as soon as any foreign matter in the way of chips, grit, or grinding dust gains access, wear and scoring proceeds quite rapidly. The extent to which the presence of chips or gritty matter can be tolerated often depends on the class of machine and the work produced on it. A massive lathe, drill or other tool producing large chips does not suffer appreciably from having the chips drop on slideways because they cannot get between the working surfaces, nor would a moderate amount of small grit damage the slides to any great extent. In such a tool as a fine grinding machine, however, a very minute amount of dust or grit in the bearings or slides would materially affect the running and quickly ruin the bearings, while the accuracy and precision of operation would immediately suffer. From this it will be evident that the same degree of protection is not necessary in all cases, and many of the devices applied to grinding machines, for instance, would be out of place and superfluous on some other types of machine tools.

A vital difference between machines using cutting tools for the removal of metal in the form of chips, and those which employ grinding wheels, is that in the former there is usually no floating metal in the air (the case of cast iron dust being excepted) while in the latter the machine may be more or less enveloped in an atmosphere of fine dust which finds its way into every unprotected part. The difference is of vital importance when the question of protecting various bearings and slides is considered; and it is found essential in the best classes of grinding machines to arrange coverings of various kinds to guard against the possibility of dust entering any of the rubbing parts. For this reason, it is never advisable to operate grinding machines close to ordinary machine tools which are not so fully supplied with protective devices; the grinding department should be enclosed and separated from other departments. An exception occurs in many tool-rooms where various high-class tools, including grinders, are grouped together; but in this case, it will generally be found that the lathes and other machines are better equipped with means for the exclusion of dust than is usual with ordinary manufacturing tools. This is partly because grinding attachments are frequently employed on the slide-rests of fine lathes and so the bearings and slides are necessarily protected more completely than would otherwise be necessary.

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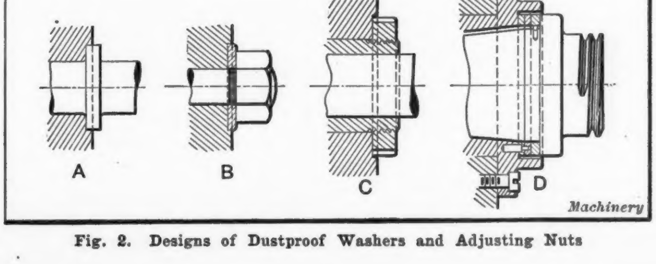


Fig. 2. Designs of Dustproof Washers and Adjusting Nuts

Another class of protection is that against damage done by having tools or the work dropped onto bearing surfaces, gears or other parts of the mechanism. Such protection is afforded, to a large extent, by the practice of guarding the gears and other parts to prevent injuring the workman; but where such guarding is not provided, special devices or modifications in construction are frequently made to render it impossible to touch an important bearing surface. It must be borne in mind that an operator is always tempted to lay a tool, spanner or piece of work temporarily upon some part of a machine, where its presence is undesirable or where damage may be caused if it falls off. Certain parts, such as slides, are sometimes built with rounded tops to discourage this practice; and some faces, including those with graduations, are sunk below the general level or protected with an overhanging lip, so that they can be seen but not touched.

A factor which assists in the protection of bearing surfaces against damage is that of arranging the lubricating systems for bearings and slides in such a manner that foreign matter is always carried outward by the flow of oil, and never has an opportunity of remaining long in a situation where it would cause scoring and wear. Where this practice is followed, any foreign matter is quickly removed, and is either trapped in shallow channels or is carried off to be separated from the oil in filtering. Nevertheless, clean oil is an essential for the lubrication of any class of slide or bearing, and care must be taken that the openings where the oil is fed in (in the absence of a pump system) do not afford any opportunity for dust or grit to enter when they are opened. The simple oil-hole is the worst offender in this respect, because it allows any matter surrounding the orifice to fall or be washed in with the oil. An oiler which stands up from the general level is much to be preferred, and its cover or cap should be arranged so that it may be opened and closed without tending to allow dust to fall, or be shaken or washed into the supply hole. The application of filtering pads or wicks laid in contact with the rubbing surfaces acts as a further precaution against the access of grit, because if properly fitted, a pad or wick absolutely prevents the transmission of any solid matter and nothing but clean oil reaches the bearing or slide.

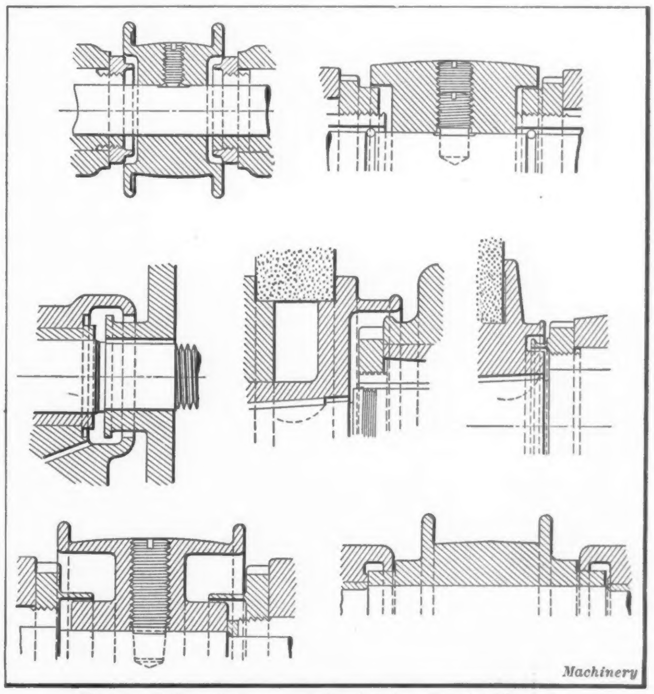


Fig. 3. Different Forms of Overlapping Constructions for protecting Shaft Bearings

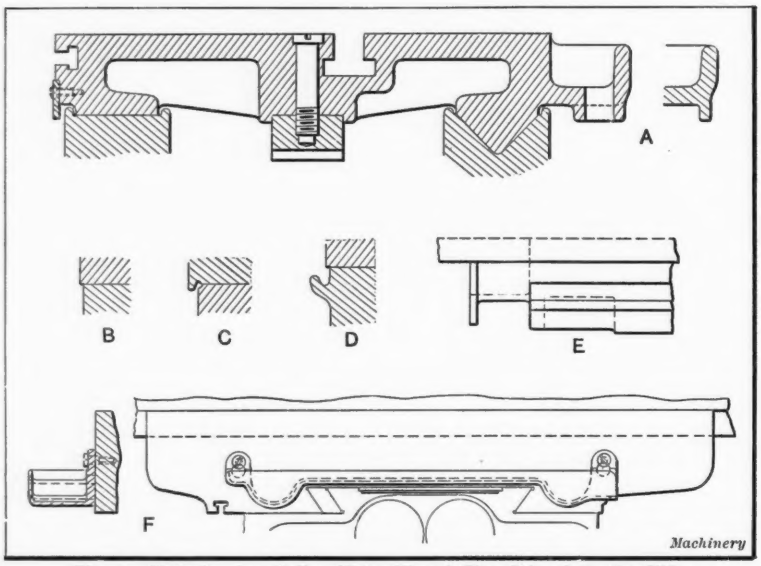


Fig. 4. Methods of excluding Dirty Oil and Fine Chips from the Slides

A distinction between the older practice and that of the last decade or so is noticeable in the extent to which protective devices are built into and embodied in the design and construction of the machines. In the older designs the protection of bearing surfaces was regarded as an unimportant detail and imperfect additions were made in the shape of sheet metal fittings, which frequently became detached from the machine and were not replaced. Now the universal tendency is to include such fittings in the form of castings and forgings, so that they must always be fully efficient from first to last, and can never fail except through being broken. And where separate plates or guards must of necessity be fitted, they are so arranged with screws and shoulders that displacement cannot happen without being at once apparent. The highest developments along this line are naturally observable in precision grinding machines, but the reaction upon other types of machine tools is noticeable. In some grinding machines the only loose protective fittings are those which have to slide or which must be easily detachable for oiling, inspection or to provide adjustment. And even in these instances, care is observed that the dust that accumulates around the apertures or upon the guard plates or covers cannot fall into the openings.

Protective devices may be classified roughly into four main types. (1) Those of a supplementary nature, attached with screws or by some other means, but otherwise stationary. (2) Those embodied in the design of castings or forgings and formed integral with them. (3) Those which slide over machine parts or telescope in conjunction with other guards. (4) Those of a flexible or a rolling nature, accommodating themselves to the movements of slides. There is much variety in regard to the design of each type of device—particularly in the first three classes—and in the following article, a selection of devices from various machines will be described to indicate the principles on which the devices are made, commencing with the simplest forms. The most primitive form of protective arrangement is that of laying boards upon a slide or bed, such as is often done with lathes to serve the double purpose of guarding the surfaces and of providing a place on which to lay a few tools and appliances. The boards are battened down to prevent them from moving laterally across the bed, and shallow ledges may be provided to retain the tools, etc. This practice is only feasible when the lathe is used for work which does not necessitate the full travel of the carriage, and is impracticable when a sliding and reverse movement takes place. But in many lathes and other machines, a saddle or base will perhaps have but a limited motion, or it may be clamped stationary for long periods, as in the case of wheel or tire lathes engaged on repetition work. Sheet steel or cast-iron covers are more durable and are preferable for wide slides or beds, such as those of large boring machines; the covers may or may not be bolted or hooked to the traveling slide.

The protection of the smaller slides, such as those of lathe slide-rests or of grinding machines, is a somewhat simpler matter as regards permanence of fitting, because the covers can be made the full length necessary to exclude chips or dust. It is simply a question of the choice of a cover cast integral with the upper sliding portion, or of a separate cover screwed or hooked in place. Fig. 1 illustrates the two alternatives, the cover shown at *A* being cast integral with the slide, and those shown at *B* and *C* screwed and hooked in place, respectively. The correct practice in these designs, as with the larger tables of some machines—particularly grinders—is to have the slide, including the end covers, of sufficient length to always keep the bearing surface protected. In the long tables of plain and universal grinding machines, it is sometimes the practice to cast the protective ends on, and sometimes to have them loose and bolted or hooked in place, as shown at *D*. A precaution observed in

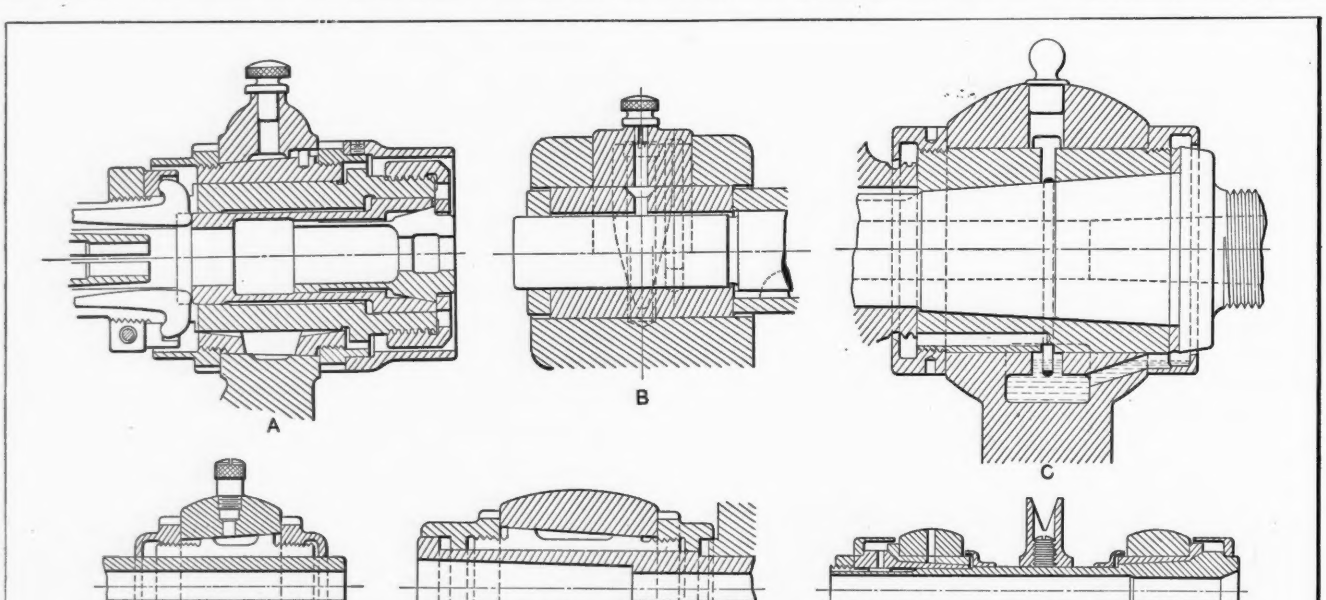


Fig. 5. Various Devices for excluding Dust and Grit from Shaft Bearings

the design of some covers is to form a slight lip or hanging flange at the end, so that any grit or dust mixed with oil or water which falls or is washed over the end will not creep along underneath the plate and so reach the bearing surface. A rib for this purpose is shown at *E*, together with the alternative method shown at *F*, which consists of a plate screwed onto the end of the cover.

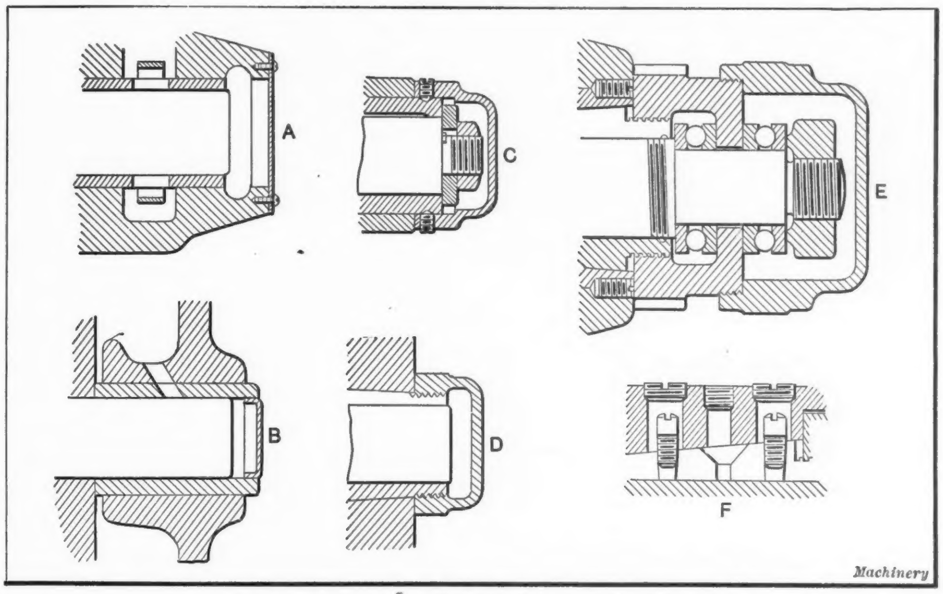


Fig. 6. End Covers for Shaft Bearings and Adjusting Nuts

The troughs or oil-lips which necessarily surround the tables and slides of machines using lubricant play an important part in the protection of slide-ways. They extend over the ways and prevent chips falling on them; but when the lip space is insufficient or the trough becomes choked, there is no guarantee against chips falling over the edge, and there is the risk of the finer chips sliding over the edge and working down onto the slide-way. Two devices may be adopted to prevent this contingency: one is to make the trough with a hanging lip on the bottom edge so that the cuttings must perforce fall clear of the slide-way; the other is to make the latter of slightly less width or diameter than the superimposed one. The cross-sectional view of the grinding machine table shown at *A* in Fig. 4 illustrates the advantage of a surrounding trough in preventing the access of dust to the ways of the bed beneath; and the detail shows how the continuation of the hanging lip prevents oil carrying grit or dust from creeping into the bearing. Milling machine tables are often cast in a similar manner, with a still stronger rib running around underneath, which is an important factor in stiffening the table. The way in which slides and circular tables of moderate dimensions are usually overhung is shown at *B*, *C* and *D*, the types being representative of practice on milling and on grinding machines. It will be seen that three variations are given—a plain finish, an underhung lip and an oil catching lip on the lower slide, the last-named type being necessary only when the dropping of oil and dust further down on the machine must be prevented. When faces such as these are submerged in oil, there is still provision for excluding dirt in the shape of a shallow groove running around to catch the sediment and retain it until the groove is cleaned out.

Many other examples of the protection of sliding or revolving surfaces by the adoption of overhanging sections are to be met with. A design in which a lip is cast on the end of a planer table to prevent the chips from falling onto the bed is shown at *E*, the sloping faces diverting them to right and left; the same device is used in some other kinds of tables to throw the chips away to a place where they are harmless. Or, as shown at *F*, a removable tray may be hitched over screws and used to prevent any fine chips from dropping onto the knee of a machine. The fact that inverted slides are nearly always used in machine tools helps to eliminate the risk of chips remaining on them, because the conditions are not favorable to the retention of the chips. Another fact in favor of the exclusion of foreign matter from the shoulders of very many bearings is that the rims of pulleys extend out to some distance on one side, and so nothing beyond floating dust can well gain access. In the case of vertical shafts, a method occasionally followed is to extend the bearing boss up around the hub of the pulley, acting as a sort of wall against the ingress of any foreign matter.

The protection of vertical revolving faces affords scope for much variety, regardless of whether the rotation occurs intermittently or continuously. Even in the case of heads, shoulders, or washers which may only need to be adjusted occasionally, it is preferable to guard them against falling or floating dust, or oil-sodden matter which slides down vertical faces. Sinking the shoulder or washer a short distance, as illustrated at *A* in Fig. 2, is effectual; and the same method is followed with adjusting nuts for bearings or other parts, as shown in the same illustration at *B* and *C*. The same result is attained by extending the front of a bearing box or bushing as shown at *D*. In any of these fittings, it is very difficult for dust to gain admittance because the oil which exudes continually from the bearing tends to carry undesirable matter away, even though it may have collected around the faces. When a pulley or the flange of a grinding wheel is adjacent to a bearing, advantage is generally taken

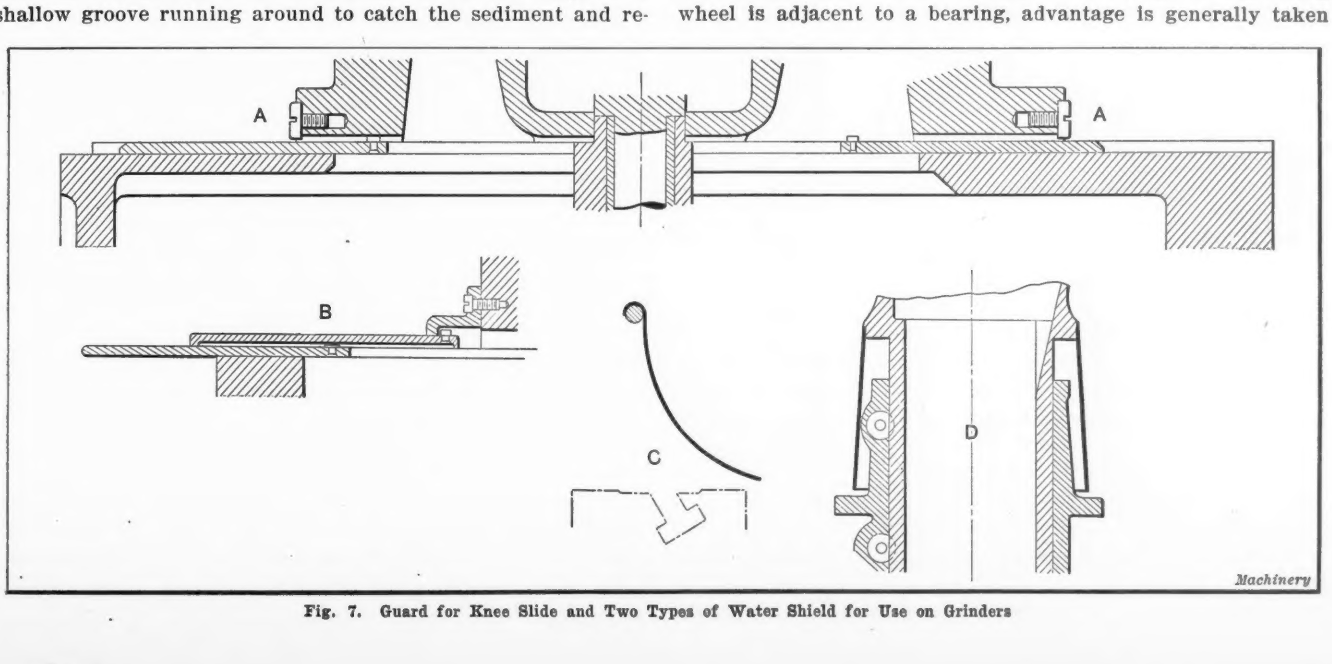


Fig. 7. Guard for Knee Slide and Two Types of Water Shield for Use on Grinders

of the fact to make an overlapping construction, either by arranging the pulley or flange to extend over a bushing or a nut of the bearing, or *vice versa*. Various examples of this kind are illustrated in Fig. 3; the employment of a beaded edge will be noticed in some of these designs, the purpose being to prevent oil and dirt creeping around to an under face, or the tendency to throw the matter outward by centrifugal force in cases where the bead is on a revolving member.

Nuts on the bearings of turret lathes and other machines are sometimes specially prolonged into a tube formation to cover a sliding part, an instance being seen at *A* in Fig. 5; it will also be seen that the chuck at the opposite side of the bearing is protected by a guard which is made to cover only a little more than half the upper part of the chuck and may be made with or without hanging sides which are carried straight down. Other devices fitted to running bearings are shown in this illustration at *B*, in which the width of the bearing box is less than that of the main casting; at *C* and *D*, where the adjusting nuts are flanged to nearly touch the rotating parts; and at *E*, where double security is offered by the construction because the nuts embrace the shoulders on the spindle and the boss of the pulley as well. Some designers prefer to fit flanged collars on the spindle, as shown at *F*, with the idea of throwing off the undesirable matter as the spindle revolves.

None of these devices absolutely guard against the entrance of foreign matter because a slight clearance must always be left between the running and the stationary members; but where a spindle is flush with the end of the bearing or projects only to a moderate extent, absolute protection is easily accomplished by using a covering cap or plate. In large bearings the use of a circular plate is frequently adopted, which is held to the end face with screws as shown at *A* in Fig. 6; or a stopper is lightly tapped into the bearing as shown at *B*. In smaller bearings, if a portion of the bushing extends, a cap can be fitted onto this bushing and locked with one or two screws as shown at *C*, and another device is to make the nut serve a double purpose, forming it with a capped end as shown at *D*. A cap supplementing the adjusting nut is occasionally more convenient when it becomes necessary to get at an end adjusting nut or screw without disturbing the bearing nut. A typical fitting of this kind, which is screwed on, is shown at *E*, while a plain push fit is made in other cases. Another variation of this device

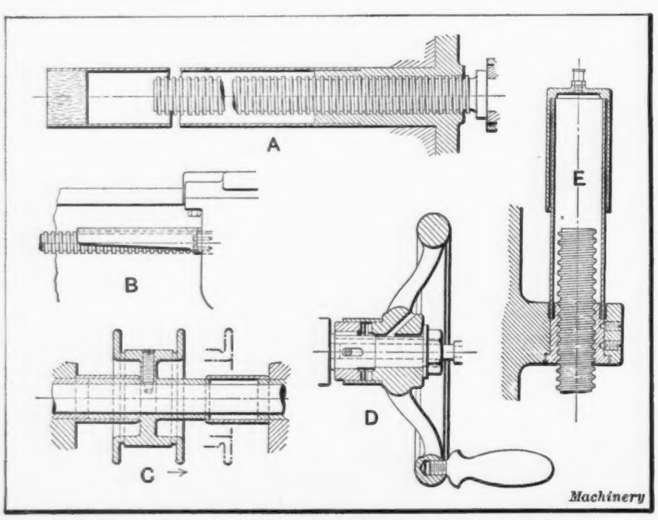


Fig. 8. Tubes for protecting Feed-screws, Splined Shafts and Clutches

is to screw a protecting cap on and pass an adjusting set-screw with lock-nut attached through the cap, so that although the running bearing is guarded, adjustments can be made from the outside. To avoid the clogging up of the nuts with dust, cap-nuts are often utilized in place of ordinary open nuts; and if certain kinds of adjusting screws are sunk below a surface, it is best to protect them with short grub screws, the method being clearly shown at *F*.

The protection of the ways of tables and slides which run on horizontal beds is, as previously mentioned, usually taken care of by the overhang of the upper parts. But floating particles will find their way where falling chips cannot and it is essential in some types of grinding machine tables to have a trapping arrangement, made on the same principle as the overlapping flanges shown in preceding illustrations. An excellent example showing the method of fitting the tables of the Blanchard vertical surface grinders is shown by Fig. 9. Here a deep groove is formed on the under side of the table, and fits over a rim standing up from the carriage. Water or grit which may reach up under the table groove is checked by the slight ridge *A* and drops from this down one of the holes in the carriage and so to the settling pan in the

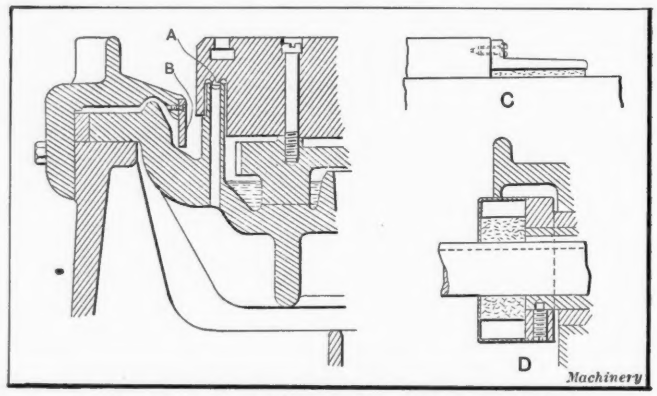


Fig. 9. Guards for Grinding Machine Tables and Felt Pads for Table Slides and Shaft Bearings

base. A hanging strip to protect the carriage slideways will also be seen at *B*. Leather or felt pads provide a means of excluding chips from sliding ways or shaft bearings and are fitted to slides of lathes, milling machines and grinding machines and to certain shafts which cannot be guarded in any other way. An example of each type of fitting is seen at *C* and *D*, the former illustration showing a projecting guard with a felt attached to make contact with a bed slide, and the latter a double spring-closed felt packing at the end of a bearing through which a splined shaft slides.

Feed-screws and adjusting-screws very often do not require special protective devices, on account of the fact that they lie within the beds and slides and are totally enclosed. If an end is exposed at intervals, this can be protected by a portion of the cover employed for protecting the slide; or a separate fitting in the shape of a tube may be applied as shown at *A* in Fig. 8. A partial protection, which is sufficient to prevent chips from falling on a screw, is shown at *B*; this device is commonly met with in screw-cutting lathes. If a shaft is exposed between two bearings, efficient protection may be afforded by fitting a tube over the intervening space. The application of two such pieces of tubing is represented at *C*, this arrangement being compulsory on account of the necessity for sliding the pulley and its spindle endwise to traverse a grinding wheel to and fro. The tubes fit close to the pulley bosses and so keep out dust. Another fitting representative of many other cases is that shown at *D*, consisting of a tube fixed on the hub of a handwheel, and of sufficient length to cover the teeth and part of the body of a clutch. Telescopic action may be desirable if the full length of a solid projecting tube is not permissible or would perhaps be unsightly. Three or four, or even more, sections of tube fitting one within another may cover a screw, or a simpler device like that illustrated at *E* may meet the requirements.

Flat or curved guards having a telescopic action are used on milling machines and grinding machines, the former for covering the knee opening, the latter for preventing water and grit from falling onto the slides or splashing outward. Fig. 7 shows at *A* how the steel guard strips are fitted in the top of a miller knee and pulled along by the action of a peg riveted in to make contact with a screw on the saddle. Double superimposed strips *B* are sometimes provided with pins and turned down edges to engage so that the plates will close up or draw out according to the position of the saddle, these being used when a single plate will not cover a space adequately. Some designs of plain and universal grinding

machines do not require telescopic water-guards because the headstock and tailstock are not fitted like those of an ordinary lathe, *i. e.*, on a horizontal bed, but are set at an angle on ways which rise up at the rear, and a long solid cast-iron guard is formed in one piece with the ways. This guard is either curved, or made with two facets at an angle to secure the effect of catching the splash and throwing it downward and forward. The steady-rests are set at the back of the guard and reach over the top and down to the required location. But when the heads are mounted like those of a lathe, the guards are collapsible, being hung on a rail as shown at *C*, and hitched together with pins or turned down edges so that they always remain together when the heads are separated widely.

A system of slide protection which has been adopted to a very limited extent is the roller-blind device; this comprises a wide roller mounted at the end of a bed, and having a spring action to automatically wind it up. A waterproof or oilproof strip or blind is attached to the roller and at the other end to the moving slide. As the latter travels to and fro the blind is drawn out or wound up, thus keeping the slideways covered. The arrangement is applied to planing machines and to surface grinding machines. A way of producing the same result on much shorter slides, as those of cutter grinders, is to attach one end of a flap of canvas or other material to the fixed slide and the other end to the moving slide, having the flap of sufficient length to give the maximum movement each way. An example of the application of a canvas or other apron is shown at *D* hung down around the column of a cutter grinding machine to throw off the water, a principle which is applied in other cases where flexibility is essential. Some horizontal spindles, those on surface grinders being a case in point, are protected with a flexible waterproof tube which is sufficiently loose or baggy to allow of the maximum to minimum adjustments lengthwise, and still excludes all water and grit. The tube may be kept out to an approximately circular shape by a spiral coil of wire inside to prevent it from touching the revolving spindle or flange.

* * *

LINCOLN'S GETTYSBURG SPEECH BROUGHT UP TO DATE

The following parody of the famous Gettysburg speech was composed by Leon Rudski, safety clerk in the master mechanic's office of the upper and lower union mills, Carnegie Steel Co., Pittsburg, Pa.

> A few years ago our industries brought forth a new idea conceived by humanitarian obligations and dedicated to the workmen's welfare by promoting "safety first." Now we are engaged in a great effort testing whether this idea, or any idea so conceived and so dedicated can stand for all ages. We have about reached the summit in promoting welfare. We have come to a point where we have decided that this safety first movement built up and operated by the industries and supervised by the government, will continue to bring welfare to the workmen in the mills and happiness to their families at home. It is altogether fitting and proper that we should have so decided. But in a large sense, the men having the safety first movement at heart and who are looking toward the betterment of their homes will profit by the opportunities offered them. The present men who are struggling to perfect the safety first movement have dedicated to the workman a humanitarian purpose that commands the admiration and respect of all mankind. The world will little note nor long remember what we say here but it can never forget what they did here. It is for us who have not been crippled, to dedicate ourselves to the great movement before us, that we here highly resolve that the efforts of the safety men shall not be in vain, that this movement shall have a new birth, and that all good resolutions for the benefit of workmen shall not perish from our land.

* * *

The present tariff law provides that all measurements of wire, metal products, etc., passing through the U. S. Custom houses shall be expressed in decimals of an inch, with the exception of steel strips. The measurement of steel strips shall be by the American or Brown & Sharpe wire gage, this being fixed as the standard. Under previous tariff laws the Birmingham wire gage was the standard for metal products measurement.

IMPORTANT DETAILS IN SOUTH AMERICAN TRADE*

In the substantial increase in trade with South America which the immediate future promises it is highly desirable that American manufacturers should keep clearly in mind some of the cardinal points of difference between South American trade usages and those of this country. It has, for instance, been emphasized many times that the social feature, almost negligible in the United States, is an important factor in trade relations in Latin America. Business is conducted more slowly in general, correspondence and personal relations do not perhaps have so much of the "touch-and-go" character, and in all commercial transactions more stress is laid on both the forms and the spirit of courtesy than in the United States. Traveling salesmen will find that they will make more progress by taking their time in working up a personal acquaintance with the trade than by attempting, even with the most favorable terms to customers, to close a sale on the first visit; and a courteous letter, written in Spanish and directed especially to the person or firm addressed (in contrast to a circular or form letter), will probably prove far more valuable as an accompaniment of a catalogue and price list than the mere catalogue itself.

Necessity of Fair Treatment of South American Customers

It is to be emphasized also that fair treatment of the customer by the American manufacturer, from the beginning to the end of a commercial transaction, is of the highest importance. In the next year or two American goods will be likely to penetrate to every remote corner of Latin America where the wares of civilization are in demand at all. Dealers who have never thought of the United States as a possible source of supply for the articles they handle will be buying from American exporters, and many will learn for the first time the meaning of the label "Made in the United States." The custom of going to Europe for certain lines of goods has become so thoroughly established that many South American dealers have little idea that their supplies can be obtained in the United States at all. Under these circumstances dealers and consuming public alike will have their first opportunity to become acquainted with American wares of every description, and it is of the highest importance that the impressions they receive, not only as to the quality of the goods, but also as to fairness of treatment by American exporters, should be favorable.

The reputation which American tradesmen and American goods will acquire in the next year or so will probably last for a generation and will have an enormous influence on the future commercial relations between the two sections. Latin-American merchants, as a rule, do not lightly change from firm to firm in their purchasing of foreign goods, and when they become assured of fair treatment from a particular export house their trade is likely to go to that house indefinitely. Much the same thing is true of the nations from which they buy, and with American goods once firmly established and American exporters found to be courteous and trustworthy, the future for our trade in Latin America will be assured. The quality of American goods, so far as they are known, is in general very well liked in Latin America, and the advantage which this gives to American exporters should not be dissipated.

Importance of Following Packing and Marking Instructions

Consular reports have from time to time cited a number of points in the commercial intercourse between South America and the United States in criticism of American methods, and while these criticisms are probably justified now in much less degree than formerly, it will doubtless be as well to point out, for the sake of those new to the trade, a few of the matters concerning which American exporters should be particularly careful. Perhaps the greatest objection to American methods heretofore has been that detailed instructions concerning packing and marking of cases, bales, etc., have been disregarded, with considerable damage and delay as a result. This has been reiterated many times, and the effect of the

* From "Daily Consular and Trade Reports," August 28, 1914.

criticism is to be seen in much-improved packing of American goods. In many ports on the east coast, and in practically all on the west coast, of South America, all goods have to be lightered to shore, and on landing are sometimes allowed to remain exposed to the weather for several days. The necessity for strong boxes and crates, well reinforced, is obvious. This subject has been discussed in detail in a publication "Packing for Export," issued by the Bureau of Foreign and Domestic Commerce and obtainable from the Superintendent of Documents, Government Printing Office, Washington, for 15 cents. Good clear marking, preferably with stencils, is of much greater importance than is generally realized, as the lack of these marks, or their failure to correspond to those in the invoice, often causes the goods to be held up in the customs for weeks and months. It is in many cases essential that the weight in kilograms shall be marked on the box, as the capacity of many of the cranes is limited. American exporters owe it to their customers to look carefully after these details, especially if the customer himself lays emphasis on the point, and they will find that attention to these matters will go far toward retaining the good will and trade of a customer once obtained.

Substitution in Filling Orders—Failure to Follow Samples and Catalogues

Another unfair practice which is sometimes resorted to and which is particularly irritating to buyers is the substitution of one type of goods for another which has been specified in the order. The needs of customers in South America are very often peculiar to their district, and substituted goods are in many cases altogether useless. When it is remembered that it may take a month to send the original order, another month to have the goods shipped, a third to complain of the substitution or return the article substituted, and a fourth to get the article originally ordered, it will be seen that one instance of this kind will be likely to kill the chances of the particular manufacturer concerned for an indefinite period. In the same class of actions is the sending of goods which do not correspond to the sample or the catalogue description from which they were ordered. It is in nearly all cases a mistake to suppose that the manufacturer knows better what a customer wants than the customer himself, but this might be said to be particularly true in South and Central America, where most of the countries are mountainous and transportation offers special problems, and where the preferences of the people have been accentuated by long use of the same kind of goods. A firm that can be depended on to send the exact goods ordered will work at a big advantage in the Latin-American trade.

Encroachment on Field of Exclusive Agents

The granting of exclusive agencies and then the indiscriminate sale of products direct to all comers is an instance of unfairness that needs only to be mentioned to be condemned. There have been many complaints that exporting firms did not observe the terms of such arrangements, and have not only sold in the territory granted to an agency, but have after a while terminated the agreement and entered the trade direct after the preliminary work and expense had been borne by the local firm. Practices of this kind are, of course, not conducive to the establishing of permanent trade relations and will be avoided by farsighted concerns. It often happens, however, that an American firm offends in this respect while acting in perfect good faith. It grants an exclusive agency to a local concern in some country and then fills orders, in the regular course of business, from an export commission house that has customers in the same territory. Fairness to the local agent requires that this should be prevented, but the best method of procedure would probably be to have an understanding in regard to the matter before the agency is granted.

The Question of Credits

The matter of credits, however, does not come under the question of fair treatment, but is simply a detail of policy in which the American practice has differed from the European. Americans sell for cash, or on a credit of one to three months; Europeans allow three to nine months, or even longer. While there is considerable complaint that American goods cannot be obtained on as favorable terms as those from Europe, there are no charges of unfairness against Americans on this account. The difference has probably been due in large part to the smaller interest in and study of the market by Americans and the consequent lack of facilities for collecting accounts and financing shipments generally. With banks of their own nationality on the ground and in intimate touch with the commercial situation, and desirous of furthering the trade of their respective countries in every way, English and German exporters have felt safe in letting accounts run for a considerable period. American exporters, on the other hand, accustomed to a more rapid turnover and operating over a long distance, often through correspondence or foreign agencies, have not considered it wise to tie up their funds or extend credits to firms with which they were out of touch for long periods.

For all exporters who are new to the field, or who are operating through salesmen or correspondence merely, it would probably be as well to continue to use caution in the granting of credits. Financial conditions in many South American countries are not on so sound a foundation as in the United States; and it often happens, besides, that beginners in business who have small knowledge of trade or of their particular line do not hesitate to lay in a large stock of goods on credit without regard to future contingencies. The credit-information facilities in many countries such as Argentina and Uruguay are said to be as good as in the United States, but the factors affecting business are perhaps more numerous and different in character than those in the United States and this makes the granting of long credits without a knowledge of the country more or less a leap in the dark. The whole credit situation is best handled by a permanent agency of the exporter, which remains on the ground year after year, and knows not only the varying phases of the economic situation but the character and standing of the commercial firms to which they sell. Perhaps the best of all mediums for keeping in touch with the credit situation is the permanently established American branch house or agency, with Americans of experience in charge. A firm with such a representative can afford to grant credit terms to compete with those of Europe, and will probably find it advantageous to do so. But others would do as well to go slowly, and at any rate to lay down a general policy of extending credit only after thoroughly satisfying themselves, from a study of the many elements involved, as to the lengths to which they would be justified in going.

Appreciation of Fairness by Latin Americans

Other points will come up as the export trade develops which the careful American house will watch closely. The essential thing, of course, is to enter the trade with a desire to treat customers fairly as well as to insist on fair treatment in return. The old trade maxim "Let the buyer beware" is a doubtful policy under any circumstances, but particularly so in dealing with Latin-American merchants. They will be found to respond quickly to any evidence of a desire to act generously with them and are as keenly appreciative of fair dealing as any other people in the world. It should be further noted that even with the best intentions on both sides misunderstandings, due to different trade customs, are likely to arise and charges of bad faith should not be made hastily or without investigation. A thorough and detailed study of the elements that enter into South American trade will on that account be found of high importance to American exporters.

* * *

It is mentioned in a recent issue of the *Standard* (London, England) that London now has a woman consulting engineer with extensive workshop and testing-room experience. She is said to have conducted researches in the laboratory of a famous engineer and holds certificates of technical education from well-known technical colleges, covering the courses in general mechanical, electrical and automobile departments. It is further stated that this very engineering lady is vexed because no engineering society as yet has admitted her to membership. She, of course, is allowed to attend the meetings, and frequently does so, but vote—no!

Fig. 2. Central Section of Table

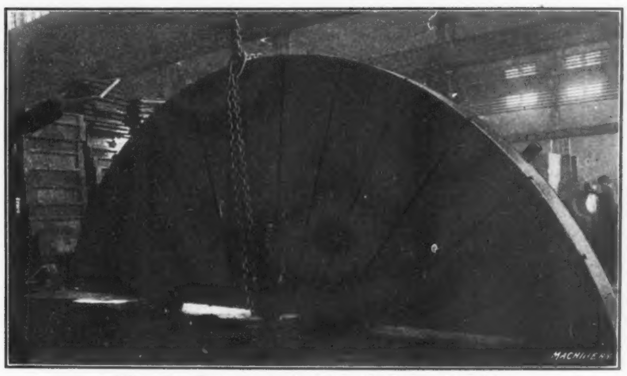


Fig. 3. One of the Outside Sections of Table

THE LARGEST BORING MILL EVER BUILT IN AMERICA

At the Brooklyn Navy Yard there has recently been completed the installation of the largest boring mill that has ever been built in this country. This mill was made by the Niles-Bement-Pond Co., at the Niles Works, Hamilton, Ohio. It swings 36 feet in diameter and has a capacity of 12 feet under the tools. The great swing of this machine is required for finishing the tracks of the immense turrets carrying the 14- and 16-inch guns of the new battleships. The mill will also be used for boring cylinders and machining the casings of the giant steam turbines for our war vessels. The significant feature about the size of this mill is that it is not of the so-called "extension" type, but it is a regular cross-rail machine with an actual swing of 36 feet 2 inches with the housings in a fixed position. An idea of the size and massiveness can be gained from the fact that the total weight, including the motors, is 665,000 pounds, or over 330 tons.

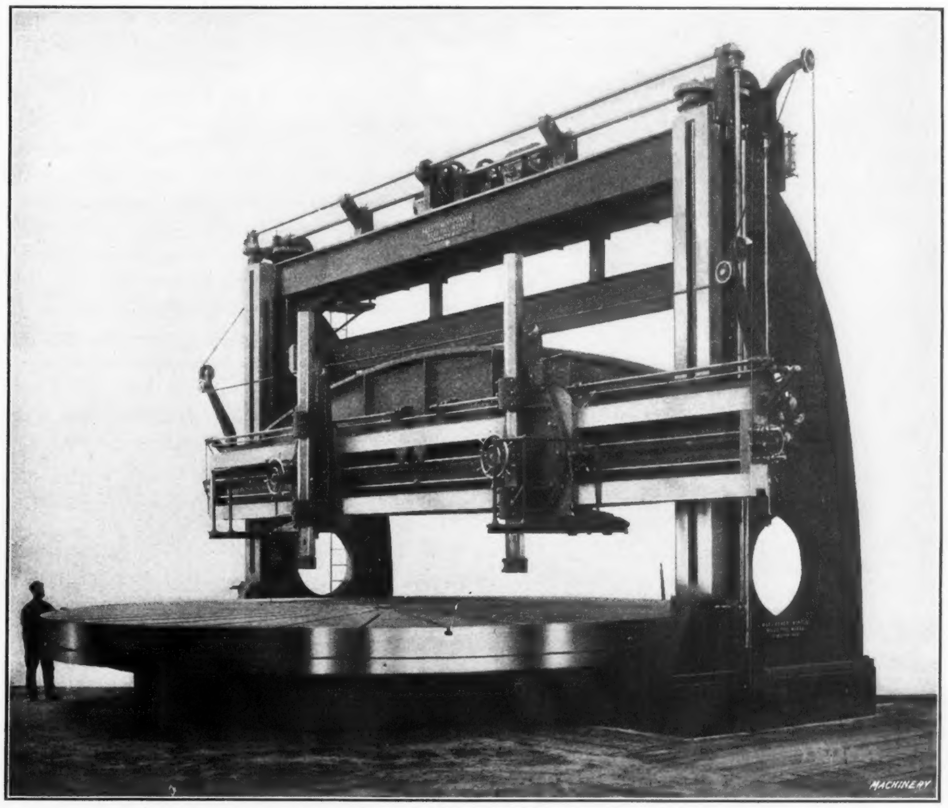


Fig. 1. Niles-Bement-Pond 36-foot Boring Mill—the Largest ever built in America

The table is designed to carry a weight of over 200,000 pounds. The extreme size of the table, which is 34 feet in diameter, made it necessary to cast it in three parts, the central and one side section being shown in Figs. 2 and 3. The three sections of the table weighed 225,000 pounds. The table is supported on conical rollers running in a circular track 24 feet in diameter, which is sunk in the bed. The rollers are of high carbon steel and fitted to the circular guide frames to insure alignment. In addition, the table rests in an annular adjustable bearing ring surrounding the central spindle. The bearing ring is adjusted vertically by steel screws. The spindle is centered in the bed by an adjustable conical bushing.

The table tracks and spindle have forced lubrication from a pump operated from the main driving motor, and the table is fitted with a spur gear 28 feet in diameter, which is a semi-steel casting, with teeth cut from the solid. It is driven by means of two forged steel pinions, placed on opposite sides of the mill. The main part of the bed is made in two sections, one of which is shown in Fig. 4, and there are two extensions attached to the main bed. The whole bed weighed 69,000 pounds and the section with the extensions, 48,600 pounds. The table tracks are rigidly supported by the vertical webs.

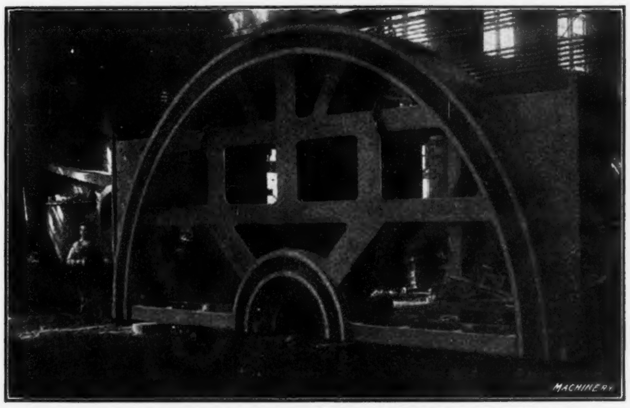


Fig. 4. One-half of Bed Casting showing Provision for Table Tracks

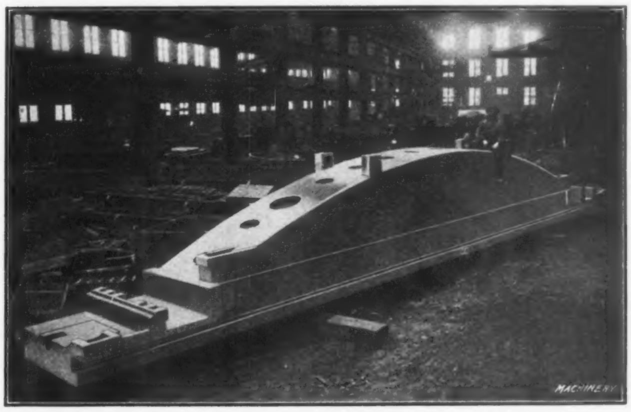


Fig. 5. Cross-rail of the Niles-Bement-Pond Boring Mill

The housings, as shown in Fig. 6, are box castings of massive construction, connected at the top by a heavy cross brace. Rigidity is further increased by a steel girder connecting the housings. Each housing weighed, in the rough, 32,000 pounds. The cross-rail, as shown in Fig. 5, is about 46 feet long and weighed 85,000 pounds in the rough. It is a box casting, and bolted to the top is a massive camber beam, the function of which is to stiffen the cross-rail and take up the sag due to the great weight of the cross-rail and the heads The combined depth of the cross-rail and the camber beam is 8 feet.

The rail is raised and lowered by means of a 30-horsepower motor located on the top cross brace and connected to four elevating screws of large diameter working in bronze nuts. The cross-rail is fitted with two heads for boring and turning. The heads are right and left, so arranged that either can be moved to the center. They are provided with graduated swivels, with worm-gearing for setting them over to any angle on either side of the vertical of 30 degrees or less.

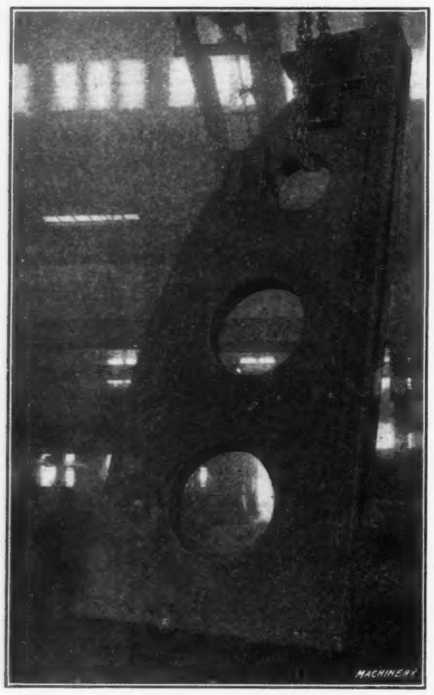


Fig. 6. One of the Housings

The heads and bars are provided with rapid power traverse, as well as hand movement for close adjustment. The rapid traverse is operated by a 10-horsepower motor located on the top brace. The control of these operations and also the engaging and disengaging of the feeds is from a platform attached to each head, upon which the operator stands. The operating levers are interlocking so that the rapid traverse cannot be engaged for one head until it is disengaged from the other, making it impossible for the operator on one head to accidentally move the opposite one.

Eight reversible power feeds are provided for the bars and are operative in a vertical or angular direction. The feeds for each head are entirely independent and positive. Means are provided by friction clutches to prevent the breakage of the feed gearing, should either bar or saddle encounter an obstruction. The main drive is by a 75-horsepower motor, and suitable speeds are provided for boring, turning and facing operations.

* * *

AUTOMOBILE SPRING WHEEL

The pneumatic tire, while one of the most perfect shock-absorbing devices known, is costly and likely to fail without warning. A great many mechanical contrivances have been invented to do away with the use of compressed air in motor tires, substituting therefor springs in various combinations. Some of these are ingenious and fairly effective. The best devices of this type are so constructed that all the springs in the radial members help support the load, no matter in what position relative to the load they may be.

The illustration Fig. 1 shows a motor car equipped with "Perfection" automobile spring wheels made by the Perfection Automobile Spring Co., Indianapolis, Ind. The wheels have traveled over five thousand miles and have been subjected to the most severe tests, one of which was crashing them against a curb at an angle of 45 degrees five hundred times to determine lateral strength.

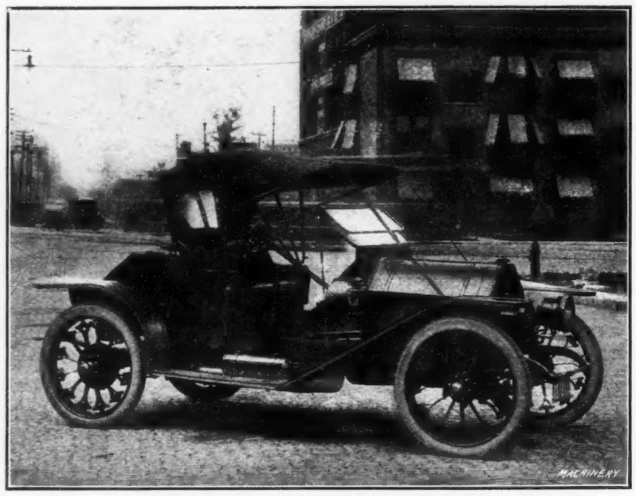


Fig. 1. Automobile fitted with "Perfection" Spring Wheels

The construction of the wheel is more clearly shown in Fig. 2. The spokes are composed of two flat special chrome-vanadium steel springs secured in the hub by wedge blocks, and are attached to the felloe by two links, the ends of the springs being curved outward in order to be attached to the links with the latter at right angles to the axis of the springs when in a normal position.

Radial movement of the hub relative to the felloe deflects the springs as indicated by the dotted lines. Lateral movement also deflects the springs, but sidewise; thus it is evident that all the spring spokes help support the load, and hence the load on each wheel is supported by twelve pairs of flat springs.

Of course no spring wheel of the rigid rim and solid rubber tire type can carry a load with as little shock as the best pneumatic tire. The unyielding form of the rim forbids this, but at moderate speeds, no doubt, spring wheel construction offers an acceptable substitute for the expensive pneumatic tire, especially for delivery wagons, light motor trucks and motor vehicles, in which dependability is a prime requisite.

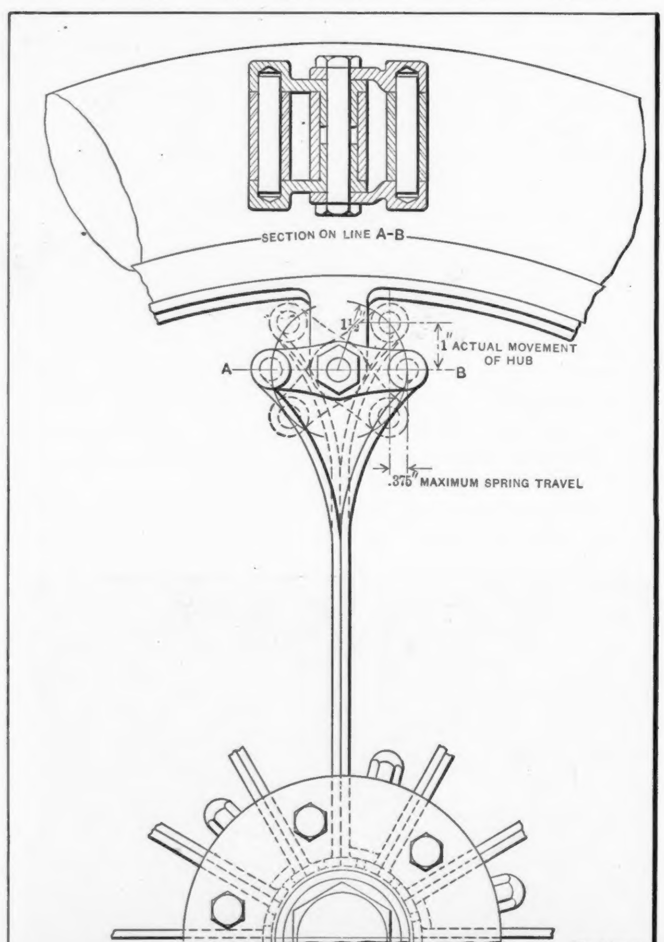


Fig. 2. Detail of Wheel showing Construction of Links, etc.

THE INFLUENCE OF CHIPS ON THE DESIGN OF TOOLS AND FIXTURES

ILLUSTRATED BY EXAMPLES SELECTED FROM VARIOUS FIELDS OF MACHINE OPERATION

BY ALBERT A. DOWD*

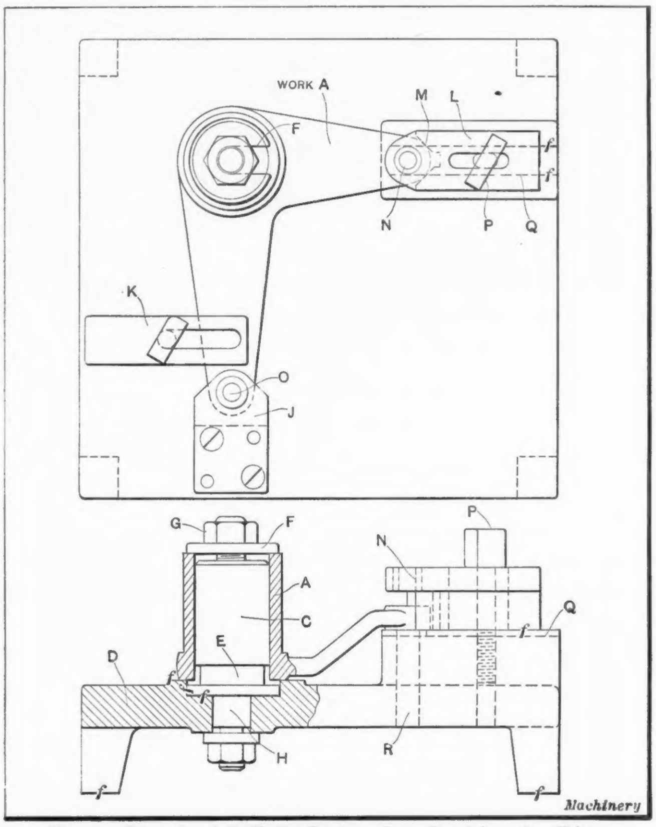


Fig. 1. Example of Drill Jig Design where Provisions for Chips are only partly considered

IN the design of all kinds of cutting tools, jigs, fixtures, and even machine tools, the chips produced by the cutting action have an influence which is of great importance. In these days when the amount of metal removed in a given time is so great in comparison with what it used to be, the importance of the matter is especially emphasized. In the design of machine tools of all kinds there are a number of points which may be traced back directly to the disposal of the chips, for example, the protection of running or sliding surfaces, such as the ways of a turret lathe. Some type of felt "wipers" are generally used for this purpose, as it is out of the question to arrange a permanent guard. When machines are used on cast-iron work some protection is greatly needed, as cast iron contains more or less sand which has an abrasive action and therefore causes excessive wear on moving parts. Cast-iron dust containing sand is nearly as destructive as emery. The writer has seen the ways of a turret lathe so badly worn when used in cast-iron chucking, that the depression could be easily seen and even felt with the fingers in some places. Felt wipers on the front end of the turret slide would have prevented a great deal of this trouble.

Gear guards are sometimes found necessary on account of flying chips, even when the gears are in a position which would not require guarding for the sake of the operator. Pans are now cast as a part of the machine bed in many cases, and adjustable guards are provided in addition, to catch chips and direct them into the pan. In the design of chucks and collets the influence of the chips is again apparent, for the chuck jaws are made of such lengths that they keep the scroll well covered under normal conditions, while collets are protected by their general construction. In milling machine construction the slide is well protected by its general design, as there are no exposed ways on which chips may find lodgment. The table, however, with its T-slots receives the chips, and provision for cleaning is therefore necessary. The slots, being open at both ends, may be easily brushed out. Table gears are in such a position that no trouble is possible here. Index heads for the milling machine have all their working parts well protected so that there is no danger of chip troubles on these mechanisms.

As cutting tools are the great producers of the chips in question, it is apparent that the matter of taking care of the chips must be carefully considered in their design. The flutes in a drill, for instance, are not made for ornamental purposes, but are a necessity in order to provide a path by which the chips may find their way out of the hole. Cutting angles of various tools, their clearance and their general shape all have to do with the making and disposal of chips. On steel work from the bar, when a roller turner is used, the angle of the cutting tool controls the form of the chip to a certain extent, and on heavy reductions of stock when a continuous spiral chip is formed, more or less clogging of the turning tool sometimes takes place. In order to prevent this trouble the Jones & Lamson Machine Co. brought out their chip-breaking turner a few years ago. Other types of tools are affected by the chips in one way or another, those working on internal surfaces being somewhat more susceptible than those used externally, on account of the difficulty of getting rid of the chips after they are made. Speaking generally, internal tools, such as boring-bars, which are to be used on steel work, require much more clearance for chips than those which are to be used on cast iron or other material having a short chip. Many a tool has proved a failure on account of insufficient chip clearance.

Jigs and Fixtures

There are several points in the design of jigs and fixtures for interchangeable work, which are of interest in their rela-

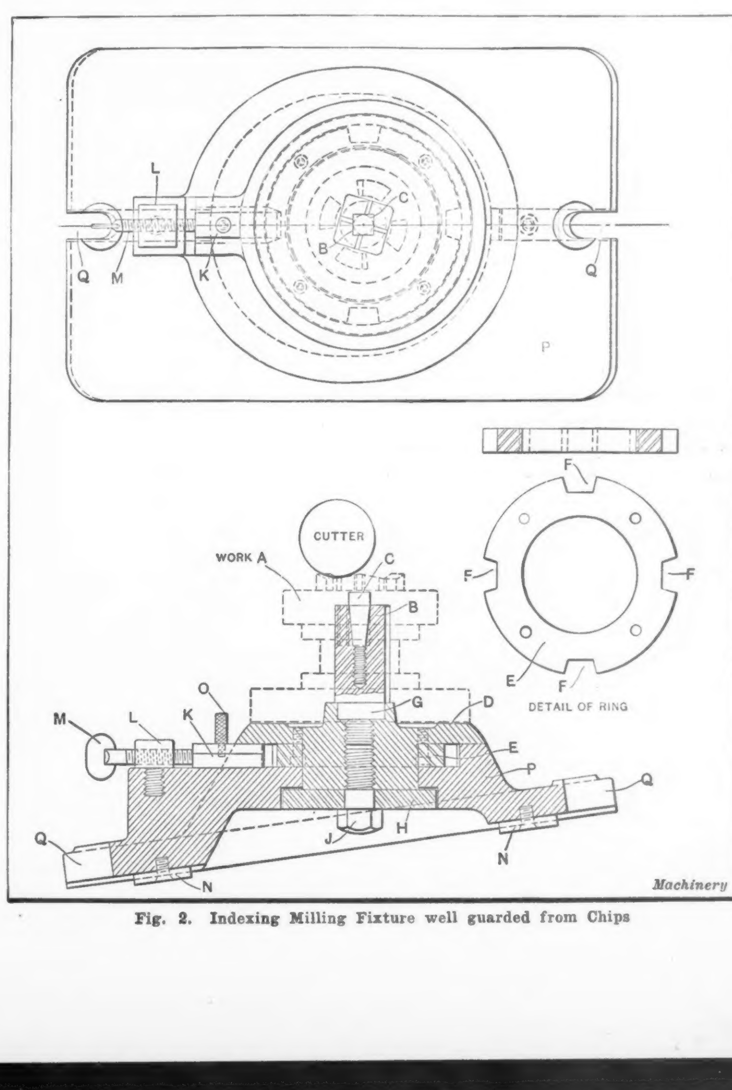


Fig. 2. Indexing Milling Fixture well guarded from Chips

*Address: 84 Washington Terrace, Bridgeport, Conn.

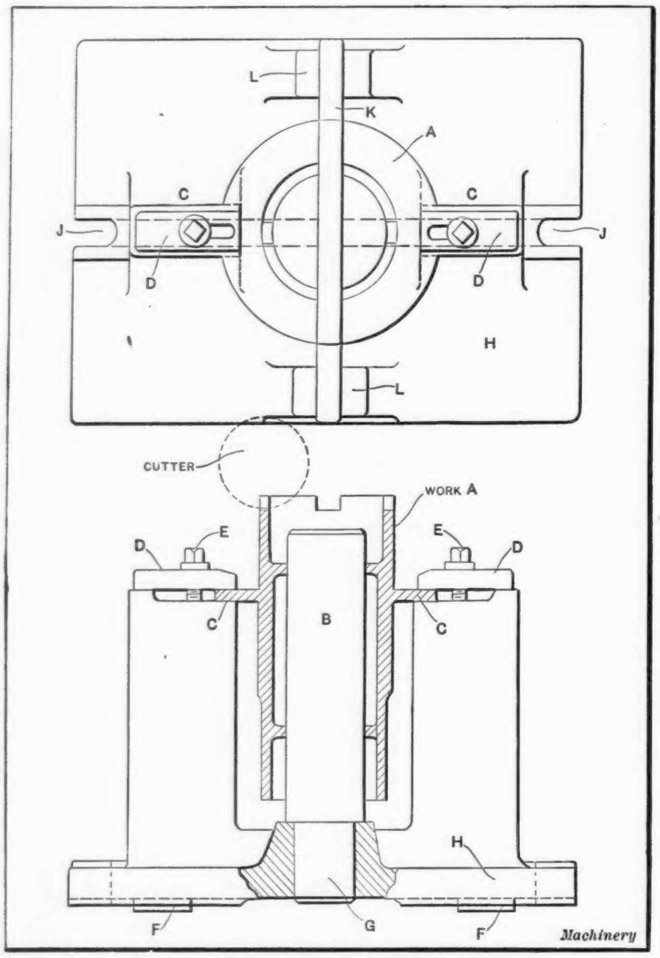


Fig. 3. Another Satisfactory Milling Fixture

tion to the chips; for example, locating points or surfaces should be so arranged that the presence of chips will not cause variations in the location of the work, and they should be easily accessible for cleaning; threaded clamp screws and other movable parts should be protected, as far as possible, in order to prevent trouble in operating; indexing fixtures should have the indexing parts so designed that there can be no chips at important points; openings should be made in the jig or fixture so that the accumulation of chips incident to the cutting operations can be quickly removed.

Fig. 1 shows two views of a drill jig for the bell-crank *A*. Prior to the operation performed in this jig, the piece has been chucked and the large hub turned, and the bosses have been faced. This example shows a peculiar inconsistency, in that the chips have been provided for in some portions and neglected in others. The casting is located on the stud *C* which fits the previously chucked hole in the work. This stud is shouldered at *H* and kept in place by the nut and washer shown. The U-washer *F*, in connection with the nut *G*, makes rapid removal easy. The shouldered portion of the locating stud sets slightly below the finished boss on which the hub of the casting rests, and is relieved at *E* in order to prevent chip troubles. As slight variations in center distances are permissible, the drilled hole at *N* is centered on the boss at the end of the bell-crank by mounting the bushing plate *M* on the sliding V-block *L* which is tongued to fit the slot *Q*, the thumb-screw *P* being used to lock the block in position. The other bushing *O* is fixed in plate *J* and a slotted clamp *K* holds the work down.

One of the peculiarities of this jig is the fact that although hole *R* has been made slightly oversize for the egress of chips formed in drilling the boss, no thought has been given to the trouble which might be caused by chips packing into the slot in the sliding block or the groove in which it travels. As a matter of fact the chips packed into the slot in such a way as to cause a great deal of annoyance, until the operator, who seemed to be of a more practical turn of mind than the tool designer, cut out a piece of tin to cover the slot; this helped the matter considerably. There was, however, no remedy for the packing in of small particles of metal under the block itself, except the removal of the sliding block from time to time to clean out thoroughly the groove in which it moved. Failure to take proper care of this matter caused angularity in the holes, due to the "cocking" of the block. This trouble was all caused by chips and could have been avoided by using a dovetailed block with a backing-up screw or something of a similar nature. It will be seen that in this particular case the tool designer's forethought took into consideration the location of the piece, but overlooked the production of chips in their relation to moving parts.

Provision for Chips in an Index Milling Fixture

In milling machine work the chips produced are inclined to be rather fine and are frequently very abundant, so that precautionary measures are of the greatest importance. A point which should not be overlooked is that a milling machine fixture is practically a part of the machine itself when it is in use, and therefore must be readily cleaned without removal from the table. Oftentimes a fixture is completely buried in chips and a designer should bear this continually in mind, so that proper precautions will be taken to avoid pockets, recesses, etc., which might be difficult to clean. In indexing fixtures special care must be taken so that there will be no inequalities of the indexing due to the presence of chips.

Fig. 2 shows an index milling fixture for an automobile clutch gear *A*, in which a square hole has been previously broached. The work done in this operation is the milling of the angles of the clutch teeth. The work is located on the

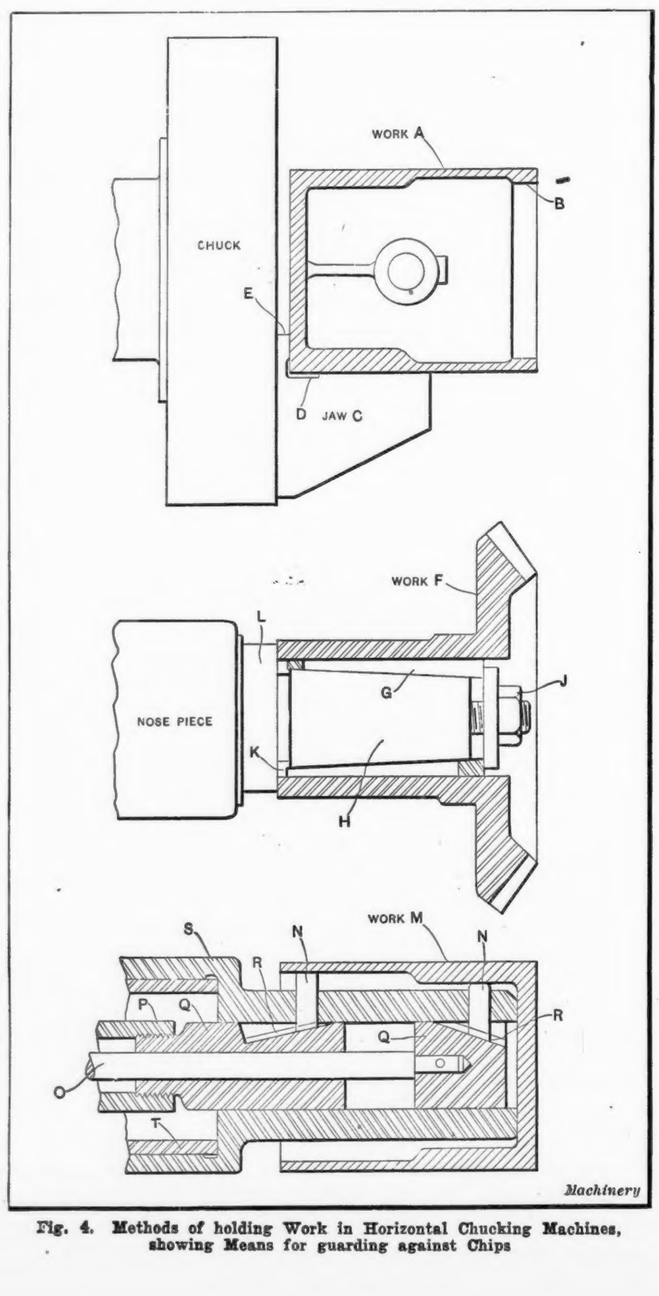


Fig. 4. Methods of holding Work in Horizontal Chucking Machines, showing Means for guarding against Chips

square stud *B* which is split in four places on its upper end and expanded by the tapered screw *C* in order to fill the hole and avoid any possibility of chatter which might be caused by a loosely fitting stud. The split feature also acts as a clamp. The stud is shouldered at *G* and screwed into the upper part of the indexing portion *D* on which the face of the larger gear rests. The index ring is screwed to the under side of this piece and the stem of part *D* extends down, having a bearing in base *P*, where it is secured by the collar and bolt *H* and *J*. The base is provided with keys *N* which fit the slots in the table, and slots *Q* for the holding-down bolts. The index ring (a detail of which is shown at the right of the illustration) is of steel and is provided with four angular slots *F*. The indexing bolt *K* is correspondingly tapered, and is tongued at the sides to fit the base. A pin *O* provides the means of withdrawal; it will be noted that the necessary movement is not sufficient to expose the angular point and thus allow chips to enter. Thorough protection is afforded both the index ring and bolt by the overhanging portion of the casting *D*. The bolt is forced into position by screw *M* acting in the swivel *L*. This fixture is an exceptionally good one, requiring very little care and having ample protection against chips.

Another Example of a Milling Fixture

The work shown at *A* in Fig. 3 is a steel hub which has been previously bored, reamed, turned and faced. The requirements for the milling operation are that the four slots must be milled at right angles to each other and perpendicular to the axis of the hub.

The base *H* of the fixture on which the work is held is provided with two keys *F* which fit the table T-slots in the usual manner, while slots *J* are used for the hold-down bolts. Stud *B*, on which the work is located, is shouldered at *G* and forced into the base. Chip troubles are here prevented by allowing a considerable amount of clearance between the lower end of the hub and the boss in which the stud is held. The fixture is also of very open construction, making cleaning easy, as

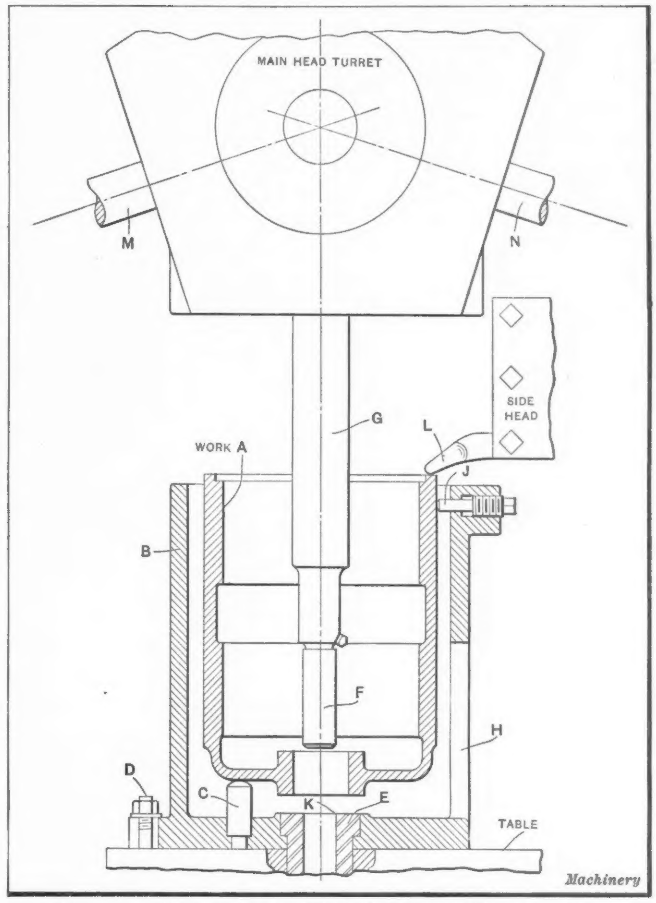


Fig. 6. Another Device for Vertical Turret Lathe where Due Regard has been given to Removal of Chips

all surfaces can be readily reached with a brush. The two uprights are a part of the base casting and are finished at *C* to receive the flange of the casting. Clamps *D* are set up by means of screws *E*. It will be readily seen that there is no chance for chip troubles on these surfaces on account of their accessibility. The indexing feature of this fixture is somewhat unusual, as no part of the fixture itself changes its position. After the cutter has cut the first two of the slots in the end of the hub, the clamps are loosened and the work is revolved on the stud until parallel *K*, guided by lugs *L*, can be pushed into position. The clamps are then set up lightly and the parallel removed, after which the clamps are set up tightly. This fixture is very satisfactory in every respect and is much less costly than an indexing fixture having a revolvable portion would have been.

Avoiding Chip Troubles in Chucking Work

In the machining of work in chucking machines, turret lathes and the like, there are fewer chances for chip troubles in the holding devices, because these are in motion and this has a tendency to throw the chips out of the way by the action of centrifugal force. Nevertheless, fine particles of sand from cast iron or steel and fine pieces of chips may cause considerable trouble unless proper precautions are taken.

The upper illustration in Fig. 4 shows an automobile piston *A* which has been previously machined on the outside. In this setting it is to be held by the outside surface and bored at *B*. It is held in the soft jaws *C* of a three-jawed chuck bored to receive it, a recess being cut at *D* so that locating troubles will be obviated. There is nothing unusual about this procedure, as it is common practice. A point in design which is frequently overlooked and which sometimes causes serious trouble is the tail *E* of the jaw. Unless this is made long enough to cover the operating scroll of the chuck perfectly, chips and dirt may find their way into the mechanism and do considerable damage. The writer has seen a chuck of this type with improperly designed jaws so badly clogged up with chips that it was impossible to use it until it had been taken apart and cleaned.

The work *F* shown in the middle illustration is a bevel gear which is to be machined on the angular faces. The split

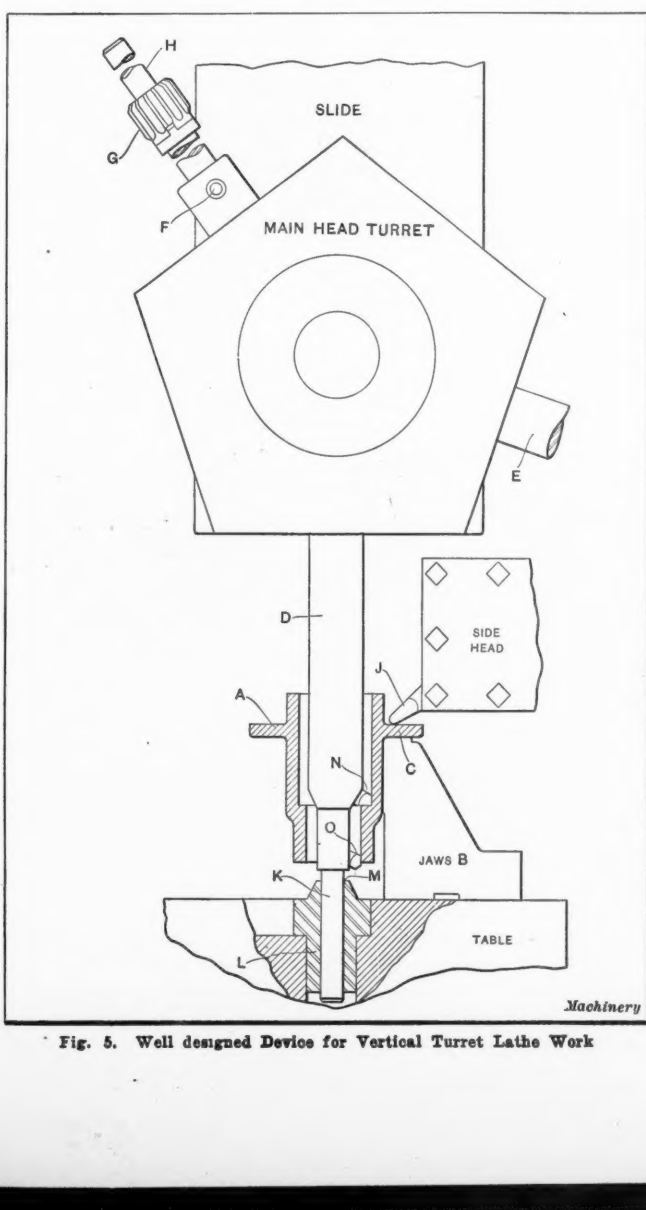


Fig. 5. Well designed Device for Vertical Turret Lathe Work

bushing *G* is forced back on the taper arbor *H* by the nut *J*. The arbor itself is held in a special nose piece on the spindle and has a shoulder *L* by which the longitudinal location of the work is insured. The relieved portion *K* of the arbor is of assistance in grinding the taper and also a precaution against dirt and chips. If used on cast-iron work, the split bushing should be taken off and thoroughly cleaned occasionally, as chips will find their way into the slots and between the bushing and the arbor, thus causing eccentricity. Troubles with expanding arbor inaccuracies may frequently be traced to this source.

The expanding-pin chuck shown in the lower part of Fig. 4 was designed for holding the piston *M* by the cored interior. Six radial pins *N* were dovetailed at their inner ends and were controlled by the dovetail slots *R* in the cams *Q* which were operated by the rod *O* and the sleeve *P*, respectively, from the rear end of the spindle. The body of the chuck *S* was screwed to the spindle as shown. This chuck is an excellent example of the troubles which may be caused by cast-iron dust, for although mechanically correct, its construction was such that particles of sand, fine chips and other foreign substances became wedged in the dovetails in such a way that its operation was seriously impaired. A leather washer in the open end helped matters considerably by preventing the dirt from getting into the mechanism. In several instances before this was done, the dovetail portion of the pins was broken off by the operator on account of the excessive power needed to operate the mechanism.

Avoiding Chip Troubles in Vertical Turret Lathe Work

In vertical turret lathe work much greater care must be used in the design of tools and fixtures than in horizontal work, as the chips naturally fall down onto the table or fixture. The table chuck on this type of machine is arranged with a set of permanent sub-jaws, lying flush with the table top and provided with a series of slots in which the upper jaws are fastened. T-slots in the permanent jaws permit quick and easy radial adjustment to approximate diameters. The scroll is well protected from chips, as the permanent jaws extend out to the edge of the table, there being a scroll controlled movement of about two inches which is sufficient to take care of any required condition.

When regular equipment and standard jaws are used there is no necessity for special precautions regarding chips, but when special tools and fixtures are used, considerable care must be taken in the design so that the devices can be easily cleaned. Movable clamps of all kinds must be so arranged that the falling chips will not clog and interfere with their use. Fig. 5 shows a hub at *A* which is to be bored, faced and turned on the upper end. The work is held in a set of special jaws *B* by the outside of the hub, the flange resting on the three points *C* on the upper parts of the jaws. In order to increase production it was desired to use multi-cutting bars as shown at *D*, and it was considered advisable to pilot the lower end of the bar in order to make it more rigid. A bushing *L* was fitted to the center hole of the table and was used as a guide for the pilot *K* of the boring-bar.

As any chips falling down and wedging around the bar would do a great deal of damage, the end *M* of the bushing was made conical, while the hole instead of being rounded or chamfered as is usually the case, was ground square and sharp. The result of this procedure was that the greater number of chips did not remain on top of the bushing, but fell to the table where they did no damage. The sharp corner in the hole did not permit any wedging action or drawing in of chips around the bar at this point. Another bar *E* used for finishing was piloted in the same manner, while the floating reamer *G* was hung loosely at *F* and piloted by the stem *H*. The side-head tools were used in connection with the boring- and reaming-bars as indicated by the tool *J*.

In vertical turret lathe work heavy castings are frequently machined which sometimes require the use of a pot of some sort as a holding device. In cases of this sort it is very important to provide means of cleaning, both because of the rapid accumulation of chips in a pot of this kind, and because of the necessity of keeping all locating points clean.

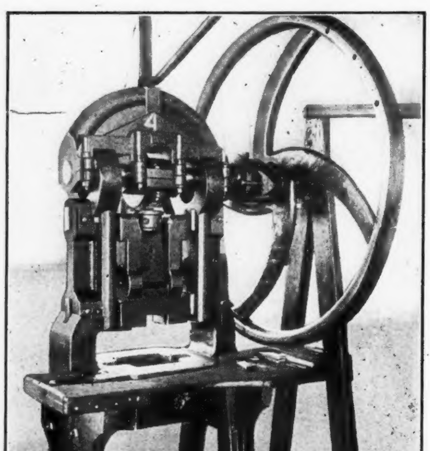
Fig. 6 is a good example of a piece of work *A* held in a pot casting *B*. This casting is centered on the table by means of the bushing *E* which fits the center hole, the fixture being held down by the bolts *D* in the table T-slots. The work rests on three points, these being pins *C* in the base of the fixture. Attention is called to the fact that the tops of these pins are rounded so that chips will not lodge there. A series of set-screws at top and bottom are arranged as shown at *J*. These set-screws are placed 120 degrees apart. It will be noted that the thread of the screws is entirely protected from chips and dirt, so that no trouble is experienced in operating, as might be the case if a regular set-screw were used with an unprotected thread. Two boring-bars and a reamer are piloted as in the preceding instance, these tools being indicated at *G*, *N* and *M*. The edge of hole *K* in the bushing is made sharp to receive the pilot *F* and the top of the bushing lies flat and flush with the fixture. There are three cored openings *H* in the walls of the pot, these being large enough to admit the hand of the operator, so that he can readily clean the locating points *C* and the bushing *E*, and free the entire interior of the fixture from chips without trouble.

The examples illustrated in this article have been chosen for their simplicity, in order to point out the importance of the subject even under the simplest conditions. In fixtures of a more complicated nature, the question of chips becomes even more important, but the same principles can be applied.

* * *

A PUNCH PRESS OF 1853

In the factory of the W. L. Gilbert Clock Co., Winsted, Conn., there is a punch press in everyday use that was built in 1853. The maker was A. Alfred, and the press was built in the town of Harwinton, Conn., a few miles from Torrington. The press does not differ greatly in general appearance from those made today, except for the large flywheel with which it is equipped. This was originally a handwheel and the side of the rim is fitted with holes so that handles may be put in, and the press operated by man-power. Later, the rim of the wheel was turned flat and the belt applied. Although the frame of the press is heavy, it has no cast-iron base and is supported on a wooden framework. An outboard bearing is provided for the right-hand end of the crankshaft, and this is also supported by a wooden framework.



A Punch Press built over Sixty Years Ago

In 1853 planing facilities were not very plentiful and it is probably for this reason that the guides or ways upon which the ram slides are made in separate pieces and held in position on the inside faces of the frame by tonguing them in rectangular holes. Each of the guides is adjustable by means of a taper square key that passes at right angles through the tongue, and by driving the keys in, the guides may be set closer together. Set-screws hold the guides in their adjusted positions. The clutch is operated by pressing the foot treadle in the usual way. This pulls out a pin that engages the heavy boss of the flywheel and thus causes the crankshaft to turn and the ram to descend. The approximate adjustment of the stroke of the press is secured by inserting large brass washers behind the adjusting screw, thus lengthening the ram. This press is still working every day at the Gilbert Clock Factory. C. L. L.

OPERATING AUTOMATIC SCREW MACHINES*

GENERAL DIRECTIONS FOR SETTING UP AND OPERATING MODEL "A" CLEVELAND AUTOMATICS

BY DOUGLAS T. HAMILTON†

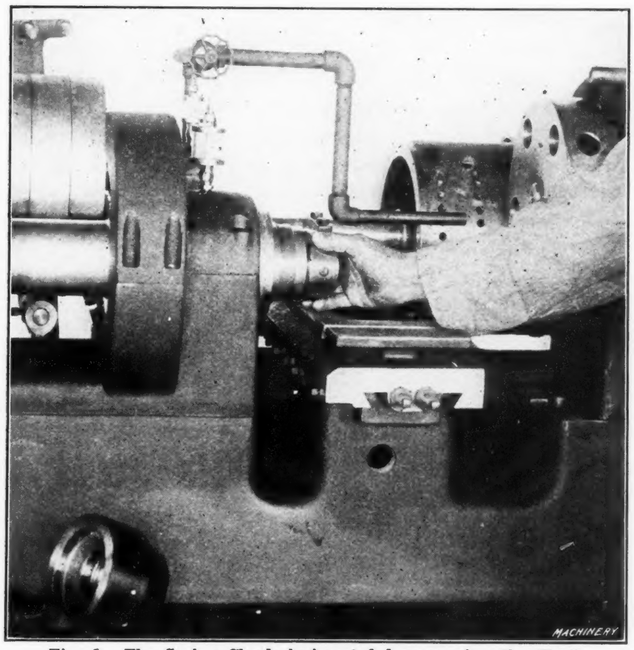


Fig. 1. The Spring Chuck is inserted by removing the Hood from the Nose of the Spindle

THE first step in setting up a Cleveland automatic screw machine is to decide on the best way of arranging the tools in relation to each other and to the work, and to select the types of tools best adapted to handle the part to be made. These points can best be illustrated by taking specific examples and drawing conclusions from them. This will be done in a following article. It is necessary, however, to first thoroughly understand the procedure in setting up the Cleveland automatic screw machine. Most of the work consists in adjusting cams, dogs and slides, etc., thus eliminating practically all calculations. To a large extent, it is simply a matter of adjusting the cams on the cross-slide drum, as well as the cams controlling the variable tool feed and the stock feed. This can be done much more easily on the machine than it can on paper because no cam cutting is necessary. Reference to Fig. 4, which shows diagrammatically the various members of the machine that require adjustment, will illustrate the points just mentioned. In the following, the method of setting up a Cleveland automatic will be treated in the order in which this work can be most satisfactorily handled.

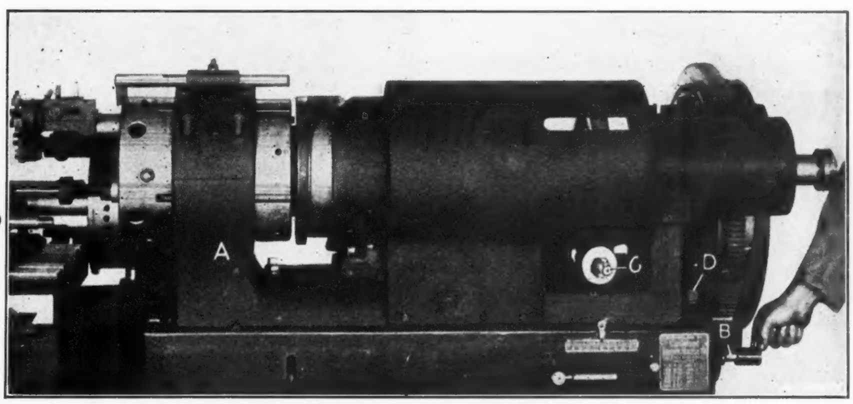


Fig. 2. The Turret Head is adjustable along the Bed to accommodate Various Lengths of Work and Tools held in the Turret

Changing the Chuck and Feed-shell

Assuming, for the sake of simplicity, that the machine has been torn down, that is, that all the tools and other equipment that has been used on previous jobs have been removed, the first step is to insert the chuck. This is being accomplished in Fig. 1. The hood on the nose of the spindle is first removed by a spanner wrench, and the chuck is then inserted, care being taken to remove all chips and heavy oil, which would retard its action. When the chuck is of the pad type, it is only necessary, of course, to remove the pads and replace them by those suited to the size of the stock that is to be handled. After putting the chuck in place, the feed-tube is then taken out and the desired size of shell or pads inserted. After putting the chuck and feed-tube in place, the chuck is then closed by hand and the cross-slide tools are placed in their approximate positions, allowing about 1/8 inch clearance between the front face of the chuck and the inner face of the cutting-off or forming tools.

Adjusting the Turret Head

Following the insertion of the chuck and feed-shell, the next move is to adjust the turret head *A* along the bed to accommodate the length of work to be turned. The operator is shown making this adjustment in Fig. 2 by means of the screw *B*. The turret should be advanced to full stroke, that is, to its extreme forward position, by means of shaft *C* operated by the same crank handle that adjusts screw *B*, and the turret tool having the greatest body length should be used in determining the position of the turret head on the bed. In making this adjustment, the clamping screws which fasten the turret head to the bed should be relieved; one of these screws is shown at *D* and the other is at the front end of the turret head underneath the bed. These should be securely tightened when the turret head is in the desired position.

Setting the Turret Tools

Turning our attention now to the turret, the first tool to be set is the gage stop. This is used for gaging the stock to the correct length and should be set in relation to the cut-off tool. The proper procedure is to measure from the outside face of the cut-off tool to the front face of the gage stop, when the turret *E*, Fig. 4, is advanced to its extreme forward position. All the other tools are then placed in the turret in their proper holes. In setting the turret tools, the exact length required for the job is secured by measuring from the face of the gage stop to the cutting tool, or

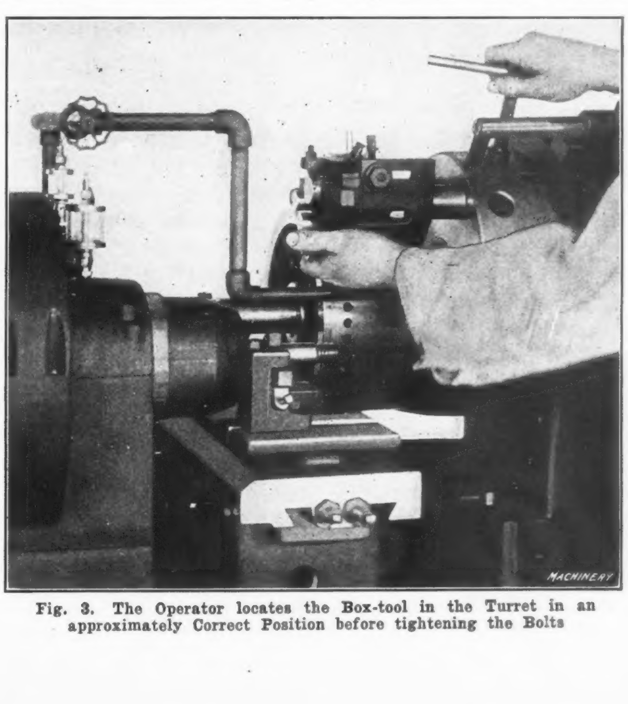


Fig. 3. The Operator locates the Box-tool in the Turret in an approximately Correct Position before tightening the Bolts

* For previous articles on Cleveland automatic screw machine practice, see "Screw Machine Tool Equipment and Attachments," September, 1914; "Screw Machine Tool Equipment," 1 and 2, July and August, 1914; and articles referred to.

† Associate Editor of MACHINERY.

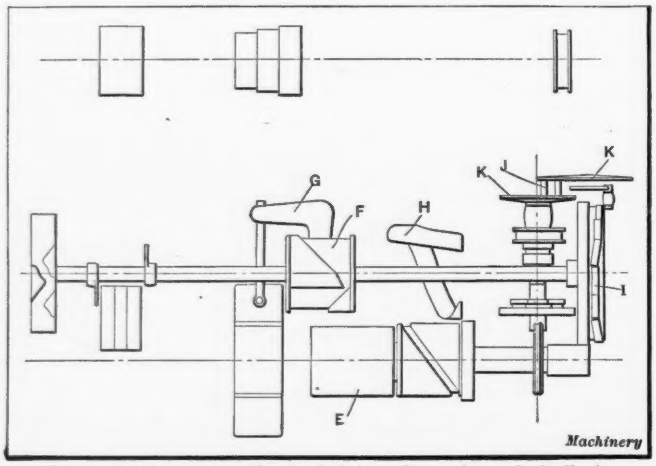


Fig. 4. Setting up the Cleveland Automatic consists principally in shifting Adjustable Cams, setting Dogs, etc.

from the outer face of the cut-off tool to the front edge of the cutting tool, with the turret advanced to its extreme forward position, as before. Fig. 3 shows an operator in the act of setting a box-tool. He first places the box-tool in the turret with the body in its correct relative position to the other tools for clearance; then he sets it lengthwise by means of a scale, as previously described, after which he tightens the clamping bolts which bear upon the shank of the tool. No attention is given to the final setting of the cutters in the box-tool until all the tools have been set in their proper relative positions.

Adjusting Cross-slide Operating Cams

The cams for operating the cross-slide are of curved segment form and are held on a drum *F* shown in Fig. 5. The procedure in setting these cams is to first advance the turret *E* to its full outward stroke and then bring the cross-slide by hand to the approximate position that the forming tool

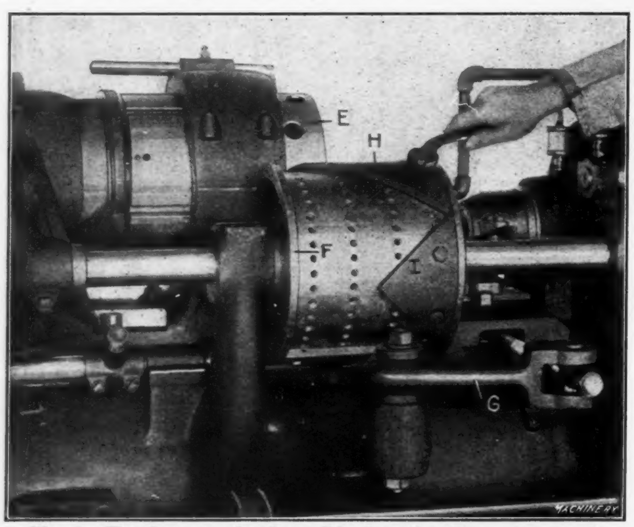


Fig. 5. The Cams on the Cross-slide Operating Drum are moved around into the Desired Position and then clamped by Cap-screws

will occupy when it has finished taking a cut. The bellcrank lever *G* is then moved until the roll touches the flange of the cam drum, and a mark is made with a lead pencil, indicating the position of the roll on the surface of the drum. Then the machine is operated again by hand, rotating the drum about one-half turn, and the high point of the forming cam *H* is placed so that it coincides with the circumference of the circle previously outlined. The cam for operating the cut-off tool is located in the same manner, and is generally the last to be set.

The relief cams *I* (only one of which is shown) that draw the cross-slide to a central position after the forming and cut-off tools have finished their operations, are next adjusted. The cap-screws fastening these cams to the drum *F* are released, and the cams are shifted around so that the high points contact with the roll and hold the slide in the central position, after which the cams are clamped to the drum.

Fig. 6 shows the method of adjusting the cross-slide connecting-rod which controls the exact position of the cross-slide as required by the movement of the forming and cutting-off tools. Two adjusting nuts provided with individual locking-nuts are on this connecting-rod and these are adjusted back and forth in relation to the central pin in the bellcrank lever *G* in order to carry the slide to its exact position. After making this adjustment of the cross-slide, the machine should be turned one complete cycle by hand to insure the operator that each tool has been properly placed.

Making the Speed Changes

The next point that requires attention is the correct spindle speed to use. This, of course, is governed largely by the material that is to be operated upon, and to some extent by

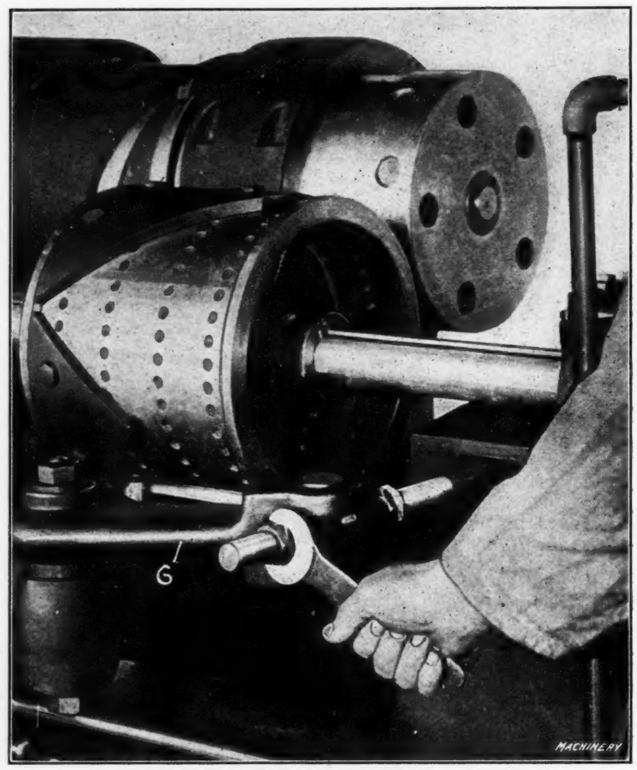


Fig. 6. The Adjusting Nuts on the Connecting-rod are for the Accurate Setting of the Cross-slide Tools

the tools that are to perform the operations. Fig. 7 illustrates the method of adjusting the belt-shifter dogs to obtain the different spindle speeds required to suit the tools that have just been placed in position. The operation of these belt-shifter dogs was clearly illustrated and described in a previous article. When a job is to be threaded with a spring or button die, or a tap is to be used, it is necessary to set these reversing dogs to reverse the spindle exactly at the time when the turret is at the full forward position. In

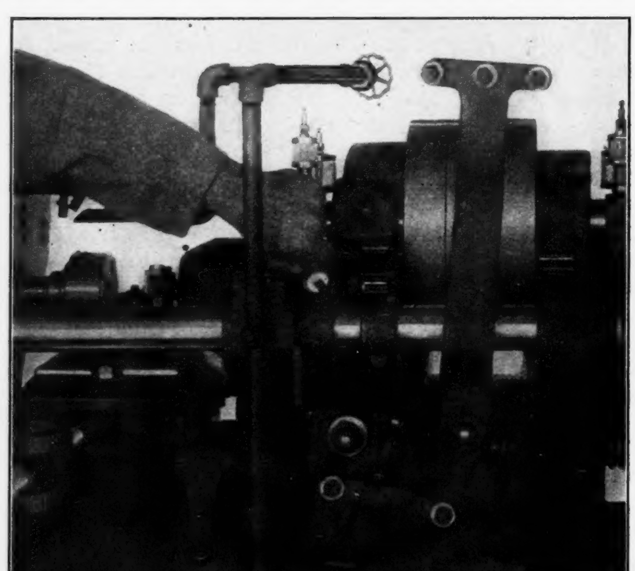


Fig. 7. Speed and Direction of Rotation of the Spindle is secured by adjusting the Belt-shifter Dogs

order to make this adjustment without danger of injuring the tap or die, the bar stock should be removed from the spindle, the turret advanced by hand to the extreme forward position and the belt-shifter dog set to reverse the spindle at this point; then the turret is backed up by hand and the power feed is thrown in, care being taken to observe whether the spindle reverses just as the turret starts on its backward motion. If the spindle reverses a little too soon or a little too late, the belt-shifter dog is adjusted slightly to correct the time of reverse. When it is seen that the spindle reverses exactly at the moment the turret starts on its backward stroke, the adjustment is correct, and the bar stock may then be replaced in the machine and the threading will operate correctly. No adjustment of this kind is necessary when self-opening dies or collapsing taps are used, as when the thread is finished the chasers clear the work and it is not necessary to reverse the spindle. There are several different combinations and arrangements of spindle drives possible on the

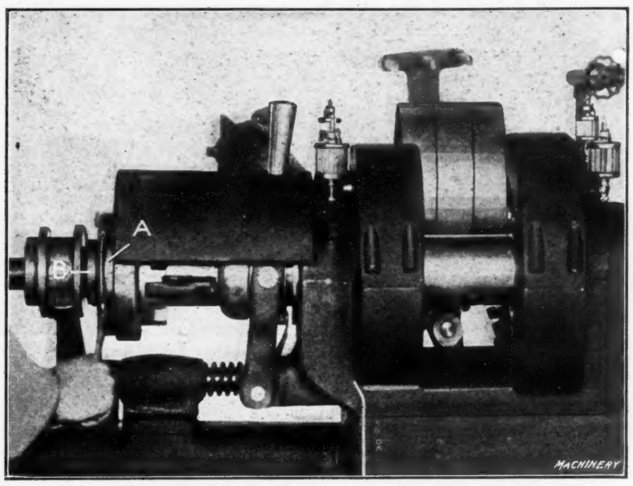


Fig. 8. The Grip of the Chuck on the Bar is governed by adjusting the Compression Collar Nut

Cleveland automatics, but these have all been described in a previous article.

Making Chucking and Feeding Adjustments

Assuming now that the tools have been set in approximately correct positions, the next step is to place the bar of stock in the spindle of the machine and adjust the chuck to its proper grip on the work. This is accomplished by means of an adjusting nut *A* shown in Fig. 8, which is located at the rear end of the spindle. In this illustration, the operator is shown turning the adjusting nut with the spanner wrench. Before adjusting this nut, it is necessary

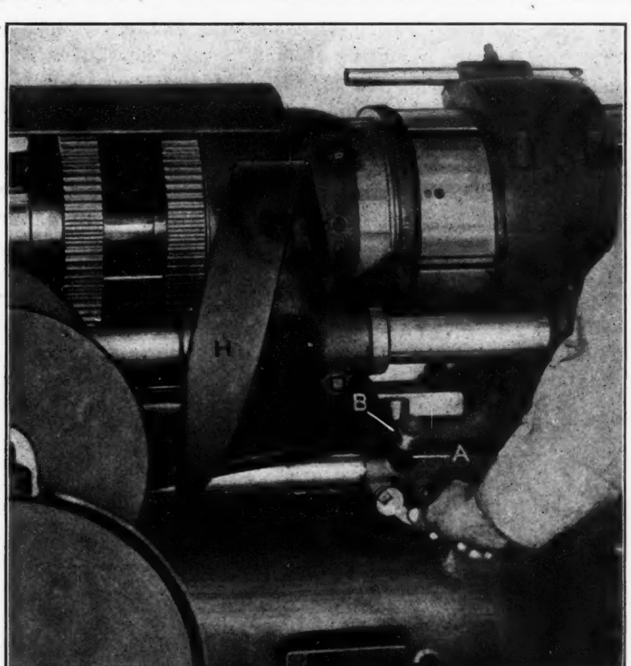


Fig. 9. The Stock Feeding Mechanism should be set to give a Greater Length of Feed than that actually required

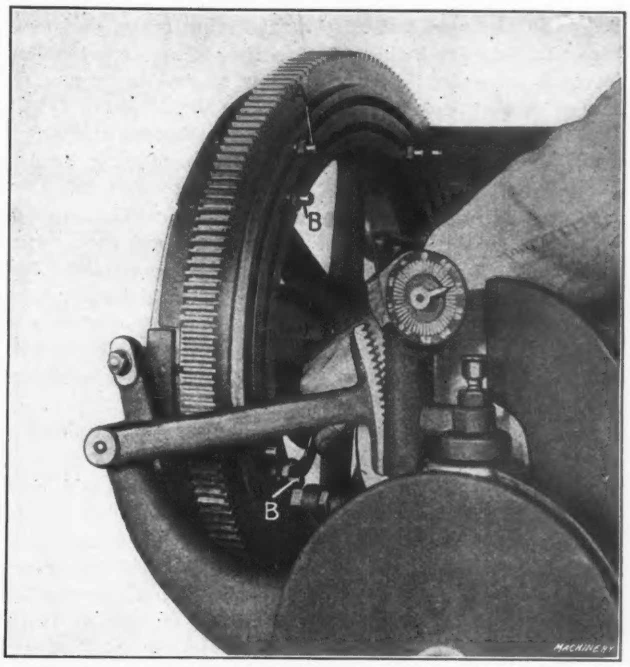


Fig. 10. Feed and Fast Idle Movements of the Tools are obtained by Shifter Pins which are Adjustable on the Regulating Drum

to release the binding nut *B* until compression nut *A* is released. Adjusting nut *A* is operated until the chuck has sufficient grip on the work to prevent it from being shifted by the action of the turning tools. When it is desired to tighten the grip of the chuck, the adjusting nut *A* is turned toward the right; turning it toward the left loosens the grip of the chuck. This direction is taken with the operator facing the spindle and standing at the front of the machine. When the correct adjustment of the chuck on the

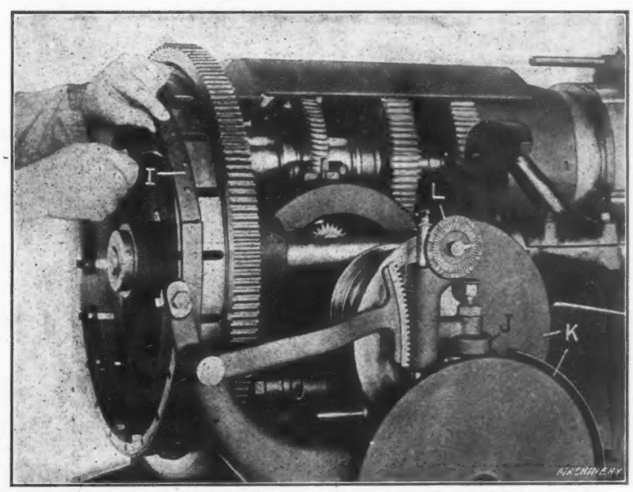


Fig. 11. A Wide Variation of Feed for the Turret and Cross-slide Tools is secured by Regulating Drum Segment Cams. These can be adjusted while the Machine is in Operation

work is obtained, the binding nut *B* is tightened to lock the adjusting nut in position.

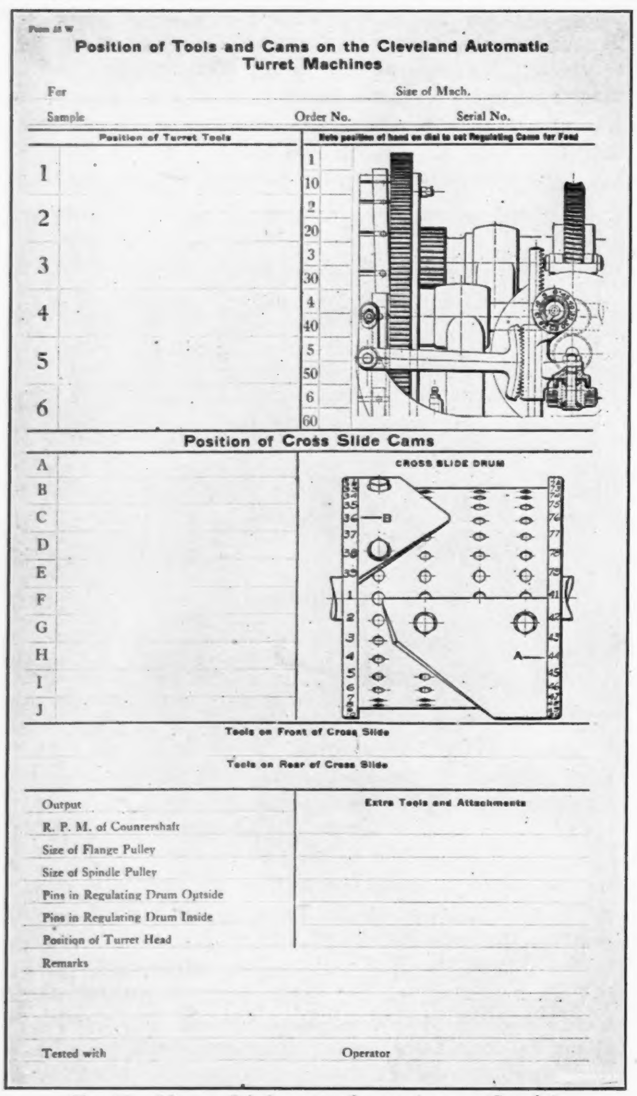
The next step is to set the stock-feeding mechanism so that the bar will be fed out to the correct distance. Fig. 9 shows the method of making this adjustment, which is secured by shifting the position of the stock feed-rod head *A* along the shaft so that cam *H* will engage with the roll *B* at a point that will feed the stock out to the desired length. The last ¼-inch movement of the stock feed-rod should take place after the chuck is opened. This will give time for the spring chuck to open fully before the stock starts to feed to the gage stop. The stock feeding mechanism should be set to feed about ½ inch more than the job requires, and the gage stop in the turret will force the stock back to the desired length just as the chuck is closing on the bar.

Setting the Feed Shifting Pins

The feed on the Cleveland automatic is changed from the slow to the fast speed through a sliding clutch. This is secured by means of shifter pins *A* and *B* which are held in

T-slots in the rear face of the regulating drum, as shown in Fig. 10. In setting these feed shifter pins, each tool in the turret is advanced by hand, that is to say, the turret is advanced so that each tool is brought to within about 1/32 inch of where it should start to cut. Then the feed shifter pin *B* is moved around in the T-slot of the regulating drum and set to shift the clutch to the slow speed at this point. In the case of a tap or die, the tool should be brought to a position 1/4 inch from the face of the work. The feed shifter pins *A* in the outer T-slot of the regulating drum control the fast or idle movements of the machine, and should be set to shift the clutch into the fast speed at the completion of each tooling cut, whereas the pins *B* in the inner T-slot control the shifting of the clutch to the slow speed and are set to move the clutch at the point previously described.

One of the many important features of the Cleveland automatic is the regulating drum, which is used for securing separate feeds for each tool in the turret and on the cross-slide, the feed per revolution of the spindle being controlled by segment cams which can be adjusted while the machine is in operation. Fig. 11 shows the operator setting or adjusting the feed regulating cams *I*. These cams are attached to the flange of the regulating drum by means of two cap-screws. The flange of the drum is slotted to allow adjustment of the cams. By shifting the position of the cams, any desired feed can be secured for each individual tool. Moving them toward the outer edges decreases the feed, and in the opposite direction increases the feed. The edges of cams


Form 25 W

Position of Tools and Cams on the Cleveland Automatic Turret Machines

For — Size of Mach.

Sample — Order No. — Serial No.

Position of Turret Tools — Note position of hand on dial to set Regulating Cams for Feed

1
2
3
4
5
6

Position of Cross Slide Cams

A
B
C
D
E
F
G
H
I
J

CROSS SLIDE DRUM

Tools on Front of Cross Slide

Tools on Rear of Cross Slide

Output
R. P. M. of Countershaft
Size of Flange Pulley
Size of Spindle Pulley
Pins in Regulating Drum Outside
Pins in Regulating Drum Inside
Position of Turret Head
Remarks

Extra Tools and Attachments

Tested with — Operator

Fig. 12. After a Job has once been set up, a Complete Record is made on this Sheet

I, through the medium of a bellcrank lever, guide the position of roll *J* automatically up and down between the friction disks *K* which drive the turret drum and cam-shaft. This makes it possible to increase or decrease the tool feed as required, to suit the material being cut and the type of tools performing the operations.

The position of the pointer on indicator *L* determines the location of the feed regulating cams when setting up a job for the second time. The indicator is held on an arm moving up and down on a post; this arm receives its motion from the bellcrank lever which, in turn, is operated by the cams on the regulating drum. The position of the pointer is recorded on a record sheet shown in Fig. 12, which should be filled out before changing to other work and used as a guide for the

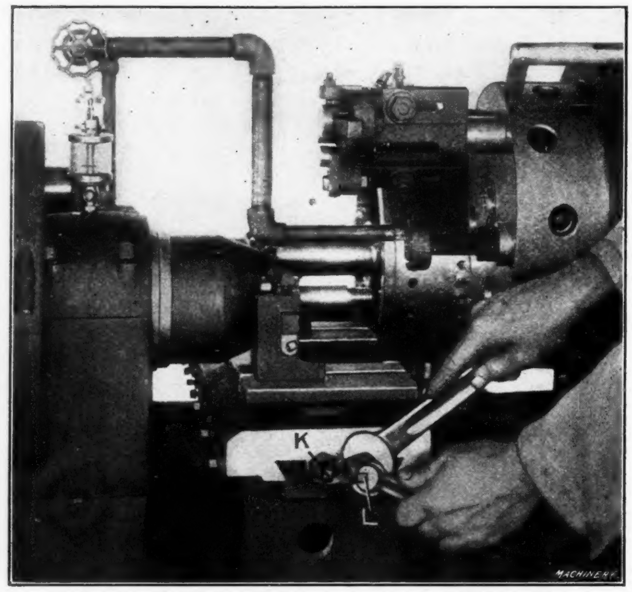


Fig. 13. Accurate Forming is secured by adjusting the Cross-slide Stop-screws

operator when setting up the same job again. This record sheet shows the position of all adjustable cams (see Fig. 4) and gives all the necessary tooling data.

The positive stops for the front and rear of the cross-slide make extreme accuracy easily obtainable. In Fig. 13 the operator is adjusting the stop *L* which controls the tools held on the front of the cross-slide, and the rear tools are adjusted by stop *K*. These stops are in the center of the slide and control the exact position of the tools. The method of setting up outlined is that followed by expert operators of the Cleveland Automatic Machine Co. and is considered the most efficient practice.

* * *

PULLING POWER OF BELTS

Some time ago an item appeared in MACHINERY calling attention to the fact that the pulling power of belts may vary with weather conditions as much as 50 per cent, being less in damp weather. This statement was challenged in a later number, but, as a matter of fact, it may be stated on good authority to be true. In carrying out some tests with a drill press, an engineer once found it impossible to obtain uniform results owing to different belt tensions. In one case, for example, using a driving pulley about sixteen inches diameter with a vertical belt to a counter pulley of about the same diameter, with an oak-tanned belt, considerably used, the results indicated that at one time the driving power of the belt was not more than two-thirds of what it was at another time; in fact, in one instance, it was only one-half. In view of the result of this experiment, where the relative power delivered could be accurately determined, there seems to be no doubt about the statement as to the pulling power varying with the weather conditions. With chrome-tanned leather belts, the losses are much less than with oak-tanned belts. Another curious result found from these tests was that a new oak-tanned belt would pull only about 50 per cent of what an old belt would. Moreover, planer operators know that there is considerable trouble with planer belts, owing to weather conditions, as planers will not reverse as rapidly in damp weather as when the atmosphere is dry.

* * *

The locks of the Kaiser Wilhelm Canal in Germany, which is playing an important part in the naval strategy of the present war, are the largest in the world, being 72 feet longer and 38 feet wider than the locks of the Panama Canal.

EDGE RADIUS OF DRAWING DIES

BY FRITZ SPARKUHL*

C. H. Rowe of Milwaukee, Wis., contributed to MACHINERY for April, 1911, diagrams showing different edges of sheet metal drawing dies and invited a discussion of the method of determining their proportions. In reply, I offer the following formula for determining this edge radius, although the wide variation in the uniformity of the metal, its smoothness and ductility, and also the surface condition of the dies, the drawing velocity, the pressure of the blank-holder, etc., prohibit the guarantee of an accurate result. But the formula at least gives the means of ascertaining the smallest allowable edge radius, beyond which it is not advisable to go.

In Fig. 1 is illustrated the edge of a first-operation die with metal flowing around it, r being the radius and t the thickness of the metal. The length of outside fiber AB is:

$$L_1 = \frac{\alpha}{360} \times 2\pi(r + t).$$

The length of the inside fiber CD is:

$$L_2 = \frac{\alpha}{360} \times 2\pi r.$$

The length of the neutral fiber EF is:

$$L_n = \frac{\alpha}{360} \times 2\pi \left(r + \frac{t}{2} \right)$$

Before passing over the drawing edge (that is with the blank in a flat condition) the length of these three fibers was:

$$L = \frac{\alpha}{360} \times 2\pi \left(r + \frac{t}{2} \right)$$

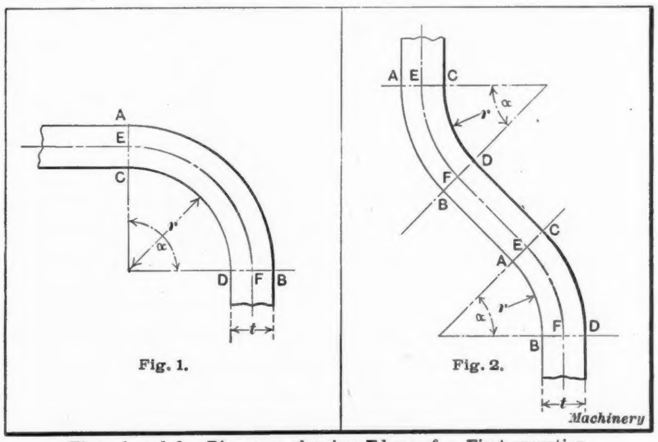
This shows that the fiber AB is subject to tension, that CD is subject to compression, and that EF as the neutral fiber remains unchanged. The difference $L_1 - L_2$ gives us the total displacement C of the metal as:

$$C = \frac{\alpha}{360} \times 2\pi(r + t - r) = \frac{\alpha}{360} \times 2\pi t.$$

As the angle is 90 degrees we have:

$$C = \frac{90}{360} \times 2\pi t = 1.57t.$$

In Fig. 2 are shown the edges of a redrawing die with an



Figs. 1 and 2. Diagrams showing Edges of a First-operation Die and a Redrawing Die

angle of 45 degrees. Considering the first edge, we see that the fibers have an original length:

$$L = \frac{\alpha}{360} \times 2\pi \left(r + \frac{t}{2} \right)$$

After the first drawing operation, the length of the outside fibers AB is:

$$L_1 = \frac{\alpha}{360} \times 2\pi(r + t).$$

Similarly, the length of the inside fiber CD is:

$$L_2 = \frac{\alpha}{360} \times 2\pi r.$$

In passing to the next drawing edge, the fibers AB will be compressed and the fibers CD elongated, while the fibers EF remain the same in both cases. Both angles equal 45 degrees; therefore, the compression *versus* tension condition is neutralized and no displacement of the metal has taken place after it has passed over the second edge. The local displacement will be:

$$C = \frac{\alpha}{360} \times 2\pi(r + t - r) = \frac{\alpha}{360} \times 2\pi t.$$

With $\alpha = 45$ degrees, we have:

$$C = \frac{45}{360} \times 2\pi t = 0.785t.$$

We see that the severest test of the metal to be drawn occurs in the first operation with a displacement which amounts to $C = 1.57t$. The specific elongation is:

$$E = \frac{\frac{\alpha}{360} \times 2\pi\,(r + t) - \frac{\alpha}{360} \times 2\pi \left(r + \frac{t}{2} \right)}{\frac{\alpha}{360} \times 2\pi \left(r + \frac{t}{2} \right)}.$$

The preceding equation is readily simplified to the form:

$$E = \frac{t}{2r + t}.$$

Solving this equation for the value of r we get:

$$r = t \left(\frac{1 - E}{2E} \right)$$

For tin plate E has a value of from 10 to 20 per cent, and using one or the other of these values we get:

$$r = t \left(\frac{1 - 0.1}{2 \times 0.1} \right) = 4.5t$$

$$r = t \left(\frac{1 - 0.2}{2 \times 0.2} \right) = 2t$$

The value obtained with this formula is too close to the breaking point; therefore, we make $E = 5$ to 7 per cent, and with this safe assumption we find that r has a value of $6.6t$ to $9.5t$. This result shows that the tentative rule $r = 6t$ should be perfectly safe, although it may be advisable to raise this value to $r = 10t$, thus avoiding danger of tearing, as the metal is not always uniform. Another vital point in laying out dimensions for drawing dies is to provide the proper clearance between punch and die. The least possible clearance between these two members is evidently twice the thickness of the metal.

Let d_1 = diameter of drawing die;
d_2 = diameter of drawing punch;
d_3 = diameter of redrawing die;
d_4 = diameter of redrawing punch;
t = thickness of metal.

Expressed mathematically, using the preceding symbols, we have:

$$d_1 = d_2 + 2t \qquad (1)$$
$$d_3 = d_4 + 2t \qquad (2)$$

But experiments have proved that the thickness of the metal increases from 10 to 20 per cent during the drawing process, and therefore an additional clearance has to be allowed, thus changing Formulas (1) and (2) to

$$d_1 = d_2 + 2(1.1 \text{ to } 1.2)t \qquad (3)$$
$$d_3 = d_4 + 2(1.1 \text{ to } 1.2)t \qquad (4)$$

A third factor to be considered is the friction between the punch and the metal, and the die and the metal. It is good practice to allow another additional clearance of $0.2t$ to $0.4t$, thus bringing Formulas (3) and (4) to their final forms as:

$$d_1 = d_2 + 2(1.1 \text{ to } 1.2)t + 2(0.2 \text{ to } 0.4)t = d_2 + 2.6t \text{ to } 3.2t \quad (5)$$
$$d_3 = d_4 + 2(1.1 \text{ to } 1.2)t + 2(0.2 \text{ to } 0.4)t = d_4 + 2.6t \text{ to } 3.2t \quad (6)$$

It is not advisable to go below these values, as the friction with its constant wear would affect the life of the tools and also necessitate an unnecessary increase of the operating power. On the other hand, if too much clearance is given, the shell will come out more of a conical than a cylindrical shape, full of wrinkles which cannot be "ironed" out by the redrawing dies, as is well known by every mechanic who has to do with this class of work. It is obvious that to produce satisfactory results, all parts of the dies that come in contact with the metal have to be in a perfectly smooth and well lubricated condition.

* * *

Little things are great to little men.

* Address: 212 Weequahic Ave., Newark, N. J.

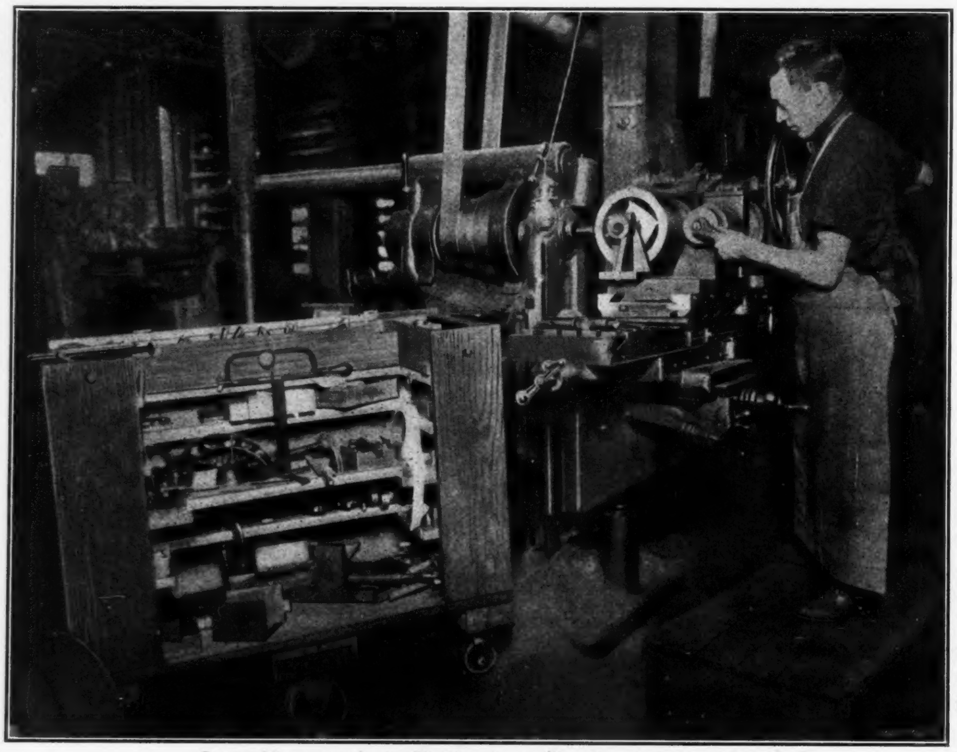
LABOR-SAVING METHOD OF SETTING UP WORK

The American Machine & Foundry Co., 346 Carroll St., Brooklyn, N. Y., builds a great variety of high-grade special machinery. As there are not a great number of parts to be made at a time, different tools have to be set up on the machines at frequent intervals, and in order to dispense with the use of high-priced labor, as far as possible, a somewhat unusual method of procedure has been adopted. When the order and blueprints for any given job come to the foreman of the department in which the work is to be done, they give the required information in regard to the tools to be used. Instead of having the man who is to do the actual work go to the storeroom and get the required jigs, tools, etc., for handling the operation, special men styled "set-up men" bring out the necessary equipment and set it up on the machine ready for the use of less experienced employes who operate the machine to produce the required number of pieces. After the set-up man has made the machine ready for use, he makes the first piece of the series, and this piece is then sent to the inspection department where it is carefully gone over to see that it meets all requirements of accuracy, finish, etc. When this first piece has been found satisfactory, the tools on the machine can be depended upon to produce the remainder of the pieces within the required limits of accuracy, and the set-up man then O. K.'s the machine and turns it over to the foreman, who, in turn, assigns any man that may be out of work to operate it.

After the operator has finished his work he removes none of the tools, but leaves the machine in exactly the same condition that he found it. The set-up man then goes back and removes the equipment and returns it to the storeroom. The set-up man is a storeroom employe and is held responsible for the tools which he takes out. In setting up a machine for any given operation, he makes a list of all the tools that are required and leaves it at the machine, so that the foreman and operator have a record of the tools which have been put out for their use. The set-up man keeps a carbon copy of this list in the storeroom, which he uses to check up the equipment when he tears down the machine. This method requires the use of a considerably higher number of machines than would otherwise be necessary, but experience has shown that the saving which is made possible through the use of cheaper labor pays very satisfactory dividends on the investment in additional equipment.

An apparently trivial feature in the application of this method, but one which really plays an important part in the efficient operation of the plant, consists of having an unusually large number of assistant foremen for the number of men employed in each department. This is made necessary by the fact that a great variety of work is constantly being handled, and as a result the inexperienced operators require quite a lot of instruction. During periods when the factory is not very busy the assistant foremen become set-up men and set-up men, in turn, are put to work as machine operators. If it is necessary to let any men go, the inexperienced machine operators who can easily be replaced are laid off. The valuable feature of this plan is that it keeps the set-up men and the assistant foremen closely in touch with the actual routine of producing the work, so that they are at all times in a position to give the best possible service in setting up the machines or instructing the operators in the best way to run them.

Each set-up man is provided with a cabinet mounted on a truck, which contains all the necessary tools, bolts, gages, etc., for use in setting up the classes of work handled in his department. The accompanying illustration shows a set-up man engaged in preparing a milling machine for cutting barrel cams. The arrangement of the tool cabinet will be readily understood from the illustration, and it may be mentioned that each cabinet is provided with a hinged cover which is locked in place every night to prevent the theft of tools. The fixture shown on the milling machine will doubtless prove interesting to some readers. It consists of a transformer which is used for milling a left-hand barrel cam from a right-hand master cam of the same form. In certain machines built by the American Machine & Foundry Co., both right- and left-hand cams of this type are required, and the use of this fixture does away with the necessity of making two master cams. The fixture itself is very simple. It consists of an arbor on which the master cam is mounted, this cam controlling the movement of the cam which is to be cut, in the usual way. In order to get a left-hand spiral in the cam which is being cut from the right-hand spiral in the master cam, the arbors on which the work and the master cam are mounted are connected by two pairs of worm-gears, one of which is right-hand and the other left-hand, the gears being similar in other respects. In this way the necessary transformation of the spiral from right-hand to left-hand is secured.



Set-up Man preparing a Machine for milling Barrel Cams—Note Portable Tool Cabinet and Fixture on Machine

To facilitate the rapidity with which tools can be set up on the tables of milling machines, etc., a tool known as a T-plate has been developed and found to give very satisfactory results. One of these plates, which is somewhat similar to a small thick T-square, will be seen on the lower shelf of the cabinet. It is arranged with a slot in both the leg and cross bar, into which a guide strip can be secured by means of screws. This guide strip fits into one of the T-slots in the table of the machine. When held in this position, the T-plate is very convenient for either setting a fixture parallel to the table or squaring it up with the table, according to the requirements of individual cases.

The machines built by this company are principally of the type controlled by automatic mechanisms which enable cheap classes of labor to be employed to run them. A noteworthy point is the wide application of different forms of cams. In certain of the machines, plate cams, edge cams and barrel cams are employed. Rarely, if ever, have all of these three forms of cams been employed in a single train of mechanism.

E. K. H.

LETTERS ON PRACTICAL SUBJECTS

We pay only for articles published exclusively in MACHINERY

PRECISION METHOD OF MEASURING ANGLES

We had to make several hundred of the parts shown at *A* in Fig. 1. The first one completed was brought, in compliance with the rule, to the inspector, who inserted two disks in the slot, and measured the distance between their centers. This method, entirely suitable for one piece, was manifestly much too slow to use where a large number had to be inspected, and some curiosity as to the means that would be adopted arose in the minds of the inspector's neighbors. In his battered old chest he was known to have a fine and valuable collection of tools, from which he had often drawn some previously unknown to his shopmates, especially convenient for some job on hand, and reputed to be of his own design and construction.

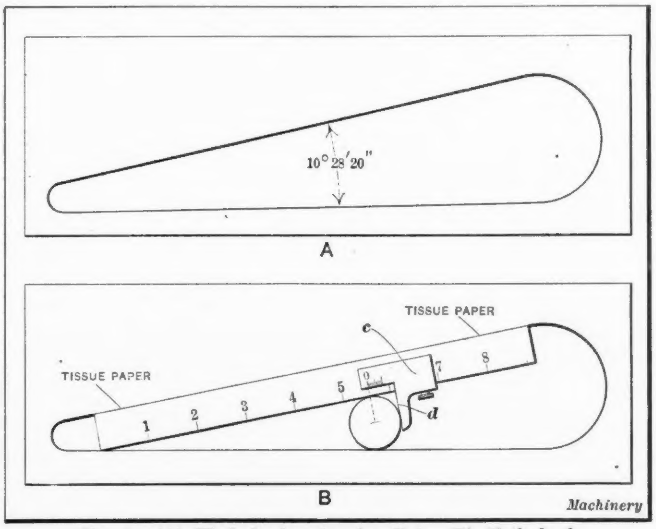


Fig. 1. (A) Work having Angular Slot. (B) Method of accurately testing Angle

In the present instance he produced from its depths a steel scale graduated in hundredths, a 1-inch disk from his micrometer case, and the attachment *c* shown applied to the scale at *B*.

This remotely resembled the attachment on the familiar Brown & Sharpe hook-rule, and, like it, was clamped to the scale by a split taper bolt. The zero mark is 0.500 inch from the side *d* against which the disk rests, and to the right of the zero are lines 0.009 inch apart. By this vernier and the 0.010-inch divisions on the scale, the setting of the disk can be made to 0.001 inch. Setting it at 5.456 inches he had a protractor of even greater accuracy than the work demanded, with which, aided by strips of tissue paper, the inspection was easily and rapidly completed by simply placing the protractor inside the angular opening as the illustration indicates.

All that is necessary in order to determine the setting for any angle within the range of this protractor is to find half the cotangent of half the desired angle. For instance, if the angle is 8 degrees, we set the zero of the attachment 7.150 inches from the end of the scale, as this dimension equals half the cotangent of 4 degrees. As the attachment can be used on a scale of any length, it is convenient in many places where a vernier protractor cannot be employed. As to its accuracy, if it were set 0.001 inch wrong—which is inconceivable—the angle would not, it is true, be 10° 28′ 20″, but the error would be less than eight seconds. In making the attachment, the vernier graduation was etched, the tool having first received a coating of asphaltum varnish, through which the lines were scratched with a height gage.

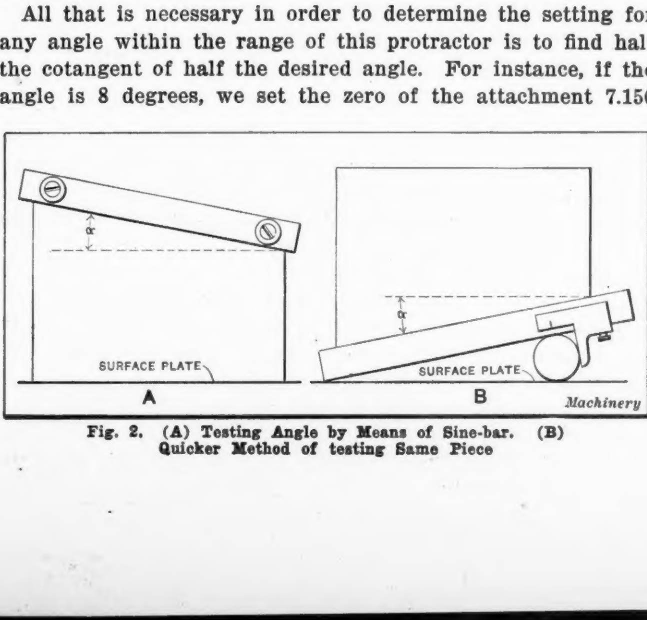


Fig. 2. (A) Testing Angle by Means of Sine-bar. (B) Quicker Method of testing Same Piece

Another kind of work for which this form of protractor is convenient is illustrated in Fig. 2. The pieces shown are to have the angle α inspected. Hundreds had been inspected by the method shown at *A*, which involves, for every piece, clamping first the work and then the sine-bar, and then, with a height gage, measuring to the top of each button of the sine-bar. When using the protractor (see sketch *B*) it is clamped in place once for all and each piece, in turn, is clamped over it, and the indicator is used (no height gage or actual measurement is required) to test the parallelism of the top of the work with the surface plate. The saving of time equals nearly two-thirds that necessary when using the sine-bar.

New London, N. H. GUY H. GARDNER

DESIGN AND CONSTRUCTION OF ELLIPTICAL GEAR PATTERNS

While much has been written upon the design of elliptical gearing, most of the methods require the use of so much mathematics that the average mechanic lacks the courage to apply the rules to actual practice, and for this reason one of the very best and cheapest of all quick-return motions for shapers, presses and punching machines has never come into popular use. It is the intention of the writer to show that little, if any, mathematical treatment is required when the gears are to be cast from patterns, and that the making of these patterns is a very simple matter which may be done by any patternmaker with the tools ordinarily found in the pattern shop.

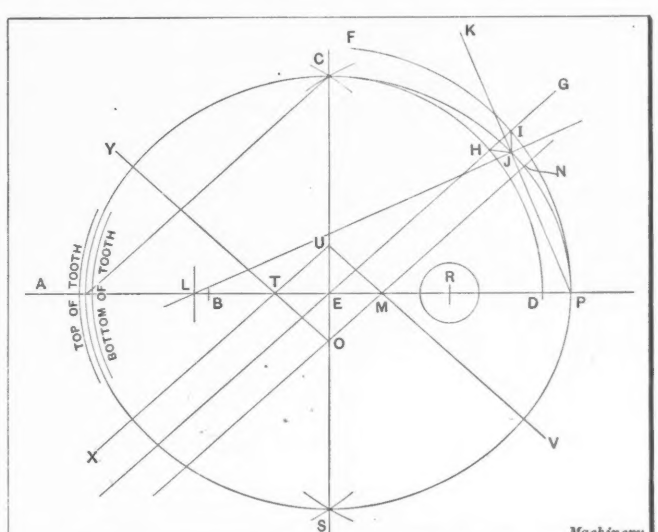


Fig. 1. Laying out an Ellipse by Means of Circular Arcs

It may be well to first define the three principal terms peculiar to an elliptical gear. They are as follows:

The major axis of the gear is its longest pitch diameter.

The minor axis of the gear is its shortest pitch diameter.

The focus is the point within the gear about which it revolves.

Referring to Fig. 1, the major axis *AP* is equal to the distance between the centers of the shafts on which the gears

are to run. The hub of the gear is placed at one of the foci B of the ellipse. The positions of the foci B and R are determined by the ratio of quick return desired; that is, the foci points B and R should be so placed that the distance PR is in the same ratio to AR as the given quick-return motion desired in the gearing. For example, in a gear the major axis of which is 8 inches a given quick-return motion of 1 to 3 is desired; then PR would equal 2 inches and AR would equal 6 inches, because $2 : 6 = 1 : 3$.

Having determined the major axis and foci of an elliptical gear, the length of the minor axis may now be found by using one of the foci B or R as a center, and, with a radius equal to one-half the major axis, cutting the line of the minor axis at C and S. When the minor axis has been found, proceed as follows to construct the ellipse: With the point E, where the major and minor axes intersect, as a center and a radius equal to EC draw arc CD; then with EP as a radius draw arc PF. Now draw a line AC as shown, and through E draw a line EG parallel to AC.

From the intersection of the line EG with the arcs CD and PF as shown at points H and I draw lines parallel to the axes of the ellipse which will intersect at point J. Draw line PK through J, and at J erect a perpendicular to line PK, intersecting the major axis at L. Next bisect LP, thus obtaining point M. Through M draw a line MN parallel to AC, intersecting the minor axis at O; lay off ET and EU equal to EM and EO, respectively, and draw UMV, UTX and OTY. Now, using M as a center and a radius equal to MP draw arc NPV. Then from center U, with a radius equal to US, draw arc VSX. From center T, with a radius equal to TA, draw arc XAY, and from center O, with a radius equal to OC, draw arc YCN. It will be found, if the work has been carefully done, that all the arcs match, giving a true ellipse.

Having obtained the pitch line of the gear in the manner described, the completion of the pattern by the forming of the teeth must next be considered. The following method has been selected because of its simplicity and the fact that no special jigs or tools are necessary in making the master pattern. The pitch of the tooth must first be decided. In the case just considered 8 diametral pitch was selected. The distance of the top and bottom of the tooth from the pitch line is now laid off on the drawing and shown by arcs drawn parallel to the pitch line from the centers M, O, T and U. The

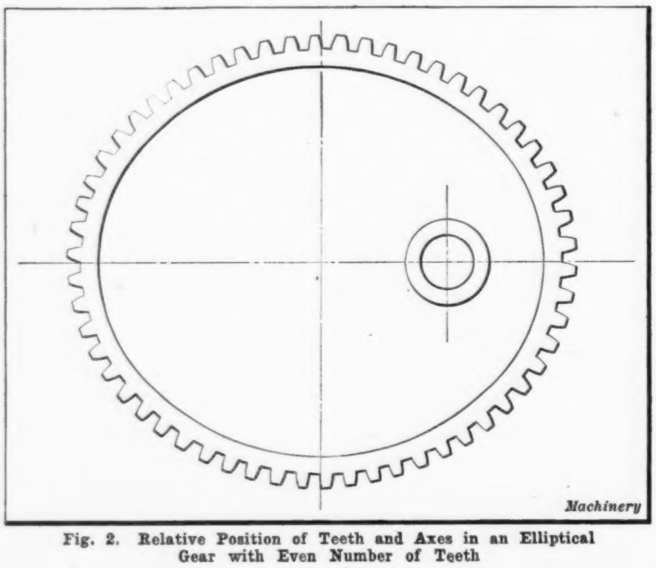


Fig. 2. Relative Position of Teeth and Axes in an Elliptical Gear with Even Number of Teeth

line of the top and bottom of the tooth being drawn as directed, the teeth may now be spaced off on the pitch circle. The simplest method for doing this is to use the dividers, which should be set at one-fourth the circular pitch of the tooth. This may be obtained by dividing 3.1416 by four times the diametral pitch of the gear. For example if the diametral pitch is 8, then $\frac{3.1416}{8 \times 4}$ equals one-fourth of the circular pitch. This distance being found, set the dividers to it and follow the outline of the pitch circle very carefully, marking every fourth step.

By using steps of one-fourth the circular pitch as recommended, the pitch line may be more closely followed and at the same time the width of the tooth and space, as well as their center lines, will be obtained. It is now a simple matter with a radius of suitable length to lay out the teeth which should be made with a simple curve, the same as commonly used on plain cast gears. This curve may be closely approximated by using a radius equal to one-fourth of OC.

If it is found after spacing the teeth that their number is even, the teeth must be located with relation to the major axis as shown in Fig. 2, but if the number of teeth be odd,

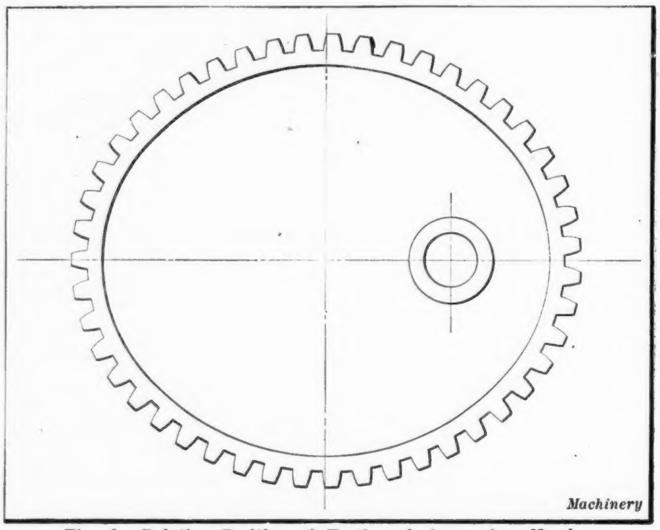


Fig. 3. Relative Position of Teeth and Axes when Number of Teeth is Odd

then the major axis must bisect a space and a tooth as shown in Fig. 3. This is necessary in order that the two gears shall mesh. It is evident that when the teeth are spaced by dividers, the spacing will not generally come out exact at the first trial. The spacing must then be increased or decreased slightly until the perimeter of the ellipse is found to be evenly divided.

It would, of course, be possible to obtain the approximate length of the perimeter by one of the empirical formulas found in handbooks for this purpose, and to find the number of teeth by dividing the circular pitch into the length of the perimeter; but as the result thus obtained would still only be approximate, trial spacing with dividers would still be necessary, and little would be gained by this procedure. Hence, the method outlined above is more practical than any in which the mathematical treatment is used.

The number and location of the teeth having been determined, it now becomes necessary to form the tooth. This may be done in two ways. If no other means are convenient, the teeth may be cut directly into the pattern by hand, using an ordinary chisel and following the exact outline of the tooth as laid out in the pattern. This method, while entirely practical, is quite slow and tedious, and where possible the following method is recommended. Having found the center line of the teeth on the pitch circle, project it to the base or root circle of the pattern, marking each point distinctly. Now cut away everything above the root circle and finish the pattern carefully to this line. Next, from a straight piece of clear grained hard wood cut a rack on an ordinary gear-cutting machine. This rack should have at least as many teeth of the same size and pitch as are required for the elliptical gear. These teeth when finished should be cut free from the rack and fastened to the elliptical gear pattern blank with wire brads and hot glue, spacing them as shown by the points previously projected to the root circle. After the glue has had time to set and the teeth are securely fastened, wax fillets should be put in and the pattern blackened and finished as customary with all master patterns, after which iron patterns should be cast from it.

It is advisable before putting too much labor into the iron patterns to prove their accuracy by placing them on gear centers and allowing them to run together. If ordinary care

has been used there should be no serious trouble, but if they seem to bind a little at certain points, these may be eased off with a file. On the whole, however, the patterns will be found entirely satisfactory and will give good smooth running gears.

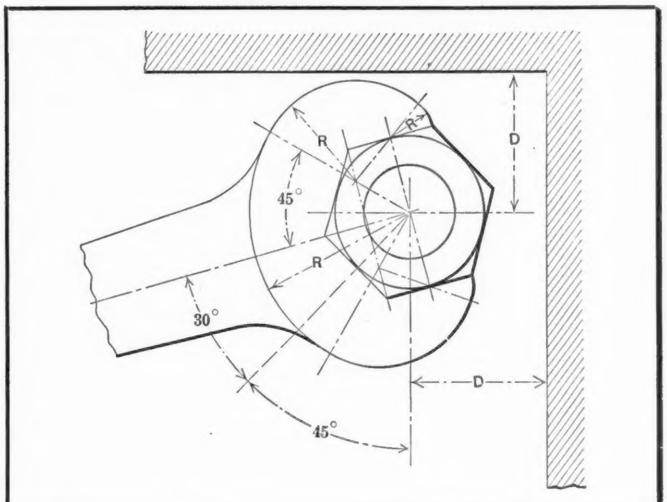
ALFRED BROWN

WRENCH CLEARANCE TABLE

In looking over the June number of MACHINERY I noticed a table of clearance dimensions for bolts and wrenches. They agree fairly well with my practice. A table which I find of considerable value is for bolts in a corner. It is there that so many draftsmen place the bolts just as close to the wall as when it is straight away. This means trouble and expense in the shop and bad language when it comes to taking apart and re-assembling the machine. The dimensions given in the table permit of swinging the wrench through an angle of slightly over 60 degrees. For the convenience of determining through what angle a wrench will swing, a method of laying out a wrench for any size nut is shown by the illustration which should be self explanatory to any draftsman.

J. L. KAY

TABLE OF WRENCH CLEARANCES



Bolt Diameter	Clearance D	Bolt Diameter	Clearance D	Bolt Diameter	Clearance D
$\frac{1}{2}$	$\frac{7}{8}$	$1\frac{1}{4}$	$1\frac{7}{8}$	$2\frac{3}{4}$	$3\frac{3}{4}$
$\frac{5}{8}$	1	$1\frac{1}{2}$	$2\frac{3}{16}$	3	$4\frac{1}{8}$
$\frac{3}{4}$	$1\frac{3}{16}$	$1\frac{3}{4}$	$2\frac{1}{2}$	$3\frac{1}{4}$	$4\frac{1}{2}$
$\frac{7}{8}$	$1\frac{3}{8}$	2	$2\frac{13}{16}$	$3\frac{1}{2}$	$4\frac{3}{4}$
1	$1\frac{1}{2}$	$2\frac{1}{4}$	$3\frac{1}{8}$	4	$5\frac{3}{8}$
$1\frac{1}{8}$	$1\frac{11}{16}$	$2\frac{1}{2}$	$3\frac{1}{2}$	..	..

Machinery

REAL EFFICIENCY IN MANUFACTURING

At one time it was, no doubt, considered that there was more money in the manufacture of parts of machine tools than of the whole machine, and in days gone by the manufacturer—not only of machine tools, but of any article subject to wear and tear—figured that the greater part of his profit was to be made in supplying repair parts. These parts were purposely made of special size or shape, so that the buyer of the original article would be forced to apply to the maker when it became necessary to make replacements. Furthermore, the manufacturer honestly believed that by making as many of the parts of his machine as possible in his own shop, his total production cost would be kept low. Hence his disinclination to buy any supplies on the outside.

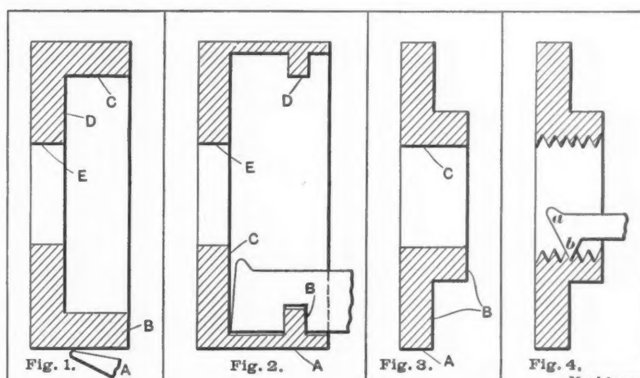
In the case of a well-known piano, the producers made a point of the fact that everything that went into the instrument, even to the smallest screw, was made in their own plant. This was, no doubt, the practice with a great many manufacturers, the idea being to impress upon the buyer their willingness to stand back of every part of their product. However, the advertising of recent years has changed all this, and we now let it be known that into our product goes this part made by Smith or that piece made by Blank & Co., because our customers have been educated by these gentlemen in the same manner as by ourselves, that is, through advertising, and we must accede to the demand that has been created. As one writer aptly says, "real efficiency can only be obtained by taking the best from all sources."

Jersey City, N. J. H. D. MURPHY

USING THE REVERSE SPEED

Why not use the reverse speed as well as the forward speed in machining work? While reading the article by Albert A. Dowd in the March number of MACHINERY entitled, "Design and Construction of Boring Tools," I recalled a number of jobs upon which several operations were performed without requiring the work to be re-set. Different tools would ordinarily have been necessary for these operations. The work referred to was done on a Hendey-Norton 12-inch lathe. The first piece to be machined was a simple casting of the form shown in Fig. 1. To avoid wasting time in changing tools, the following method of procedure was adopted. A plain round-nose tool was used, and the surfaces *A* and *B* were machined with the usual forward motion of the lathe, while the surfaces *C*, *D* and *E* were machined with the lathe running in the reverse direction. The advantage of handling the job in this way was that, in addition to the saving of time, it was possible after once setting the tool for each operation and knowing its position on the cross-feed index, to machine subsequent pieces without having to make frequent measurements to obtain the required size, as would otherwise have been necessary.

The following method was employed in machining the piece shown in Fig. 2. The forming tool was used to machine the surfaces *A*, *B* and *C* with the lathe running in the usual direction. The surfaces *D* and *E* were then finished with the lathe reversed. Figs. 3 and 4 show a job which required the face of the casting and the threaded hole to be perpendicular to each other. The tool shown in Fig. 4 was used, the edge *a* of this tool being employed for turning and facing, while the edge *b* was used for cutting the internal thread. The surfaces *A* and *B* were turned with the lathe running in the usual direction. The hole *C* was bored with the lathe reversed, after which the internal thread was cut as shown in Fig. 4.



Figs. 1 to 4. Examples of Work on which Reverse Speed was used to Advantage

Elgin, Ill. F. R. DEXTER

GRINDING AND LAPPING SMALL WORK

All mechanics experienced in fine work will no doubt agree on one point, *viz.*, that the grinding and lapping of the locating holes and pins in all hardened plates is a necessity for accuracy. It is the purpose of this article to present to the readers of MACHINERY useful information gathered from years of practical experience with this class of work.

The lap shown at *A*, Fig. 1, is used for grinding holes. It is made of drill rod and has a taper shank which fits the grinder spindle. The end should be recessed, as shown, and the lapping portion *a* should be narrow, as it cuts more free and clean than a wide end. Fig. 2 shows a rack-and-pinion device for rolling diamond dust into small laps. This was

invented by E. D. Cooke (a designer of fine tools) with whose permission it is used in this article. The lap is charged as follows: Place a very small amount of the diamond dust, mixed with sperm oil, on the lap, place the lap between the two hardened steel pieces *A* and *B*, turn the handle *C* back and forth, thus rolling the diamond powder into the steel lap. The feed-screw *D* should be lowered carefully so as not to bear too tightly on the lap. Test the lap with the finger nail and if it has a gritty feeling it is properly charged. Use coarse diamond for roughing and fine dust for finishing.

Before beginning to grind a hole be sure the lap runs true; an eccentric lap is a slow and poor grinder. Keep all laps sharp, *i. e.*, well charged with diamond dust. After a lap has been used for some time, it is advisable to make a new

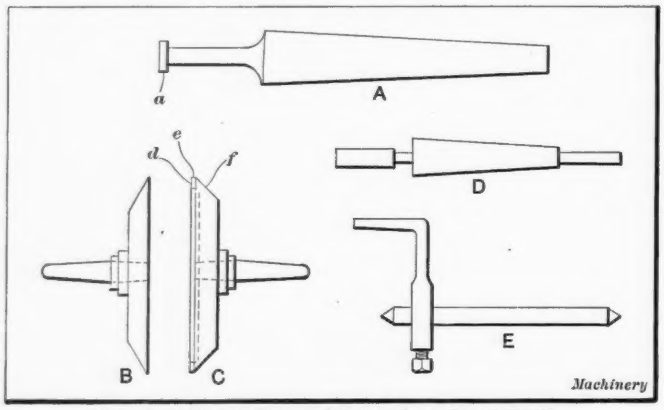


Fig. 1. Different Forms of Laps—Examples of Small Precision Work

one, as after continued use the lap becomes too hard to take the diamond readily. Do not try to crowd a lap, for that will spoil it and make a bell-mouthed hole. In order to tell when a lap is cutting use some kind of a "listener." Have the lap enough smaller than the hole to prevent excessive friction. Let the work revolve forward at low speed and the lap backward at high speed.

When grinding it is well to use an automatic feed. The illustration Fig. 3 shows one of the writer's design that is both simple and effective. It is composed of the following parts: A sheet steel extension *A* to fit the T-slot in the slide-rest; a binding screw *B*; a cam *C* attached to a vertical shaft which is rotated through worm-gearing by belt pulley *D*; and a grinder spindle *E*. This feeding mechanism is adjustable in every direction. On large laps use a sponge saturated with oil, and when using inside laps have a tin guard to stop flying oil.

At *B*, Fig. 1, is shown a diamond lap used for grinding V-slots, to make a slot central on round work. When doing work of this kind, grind one side at a time, indexing half way round for each operation.

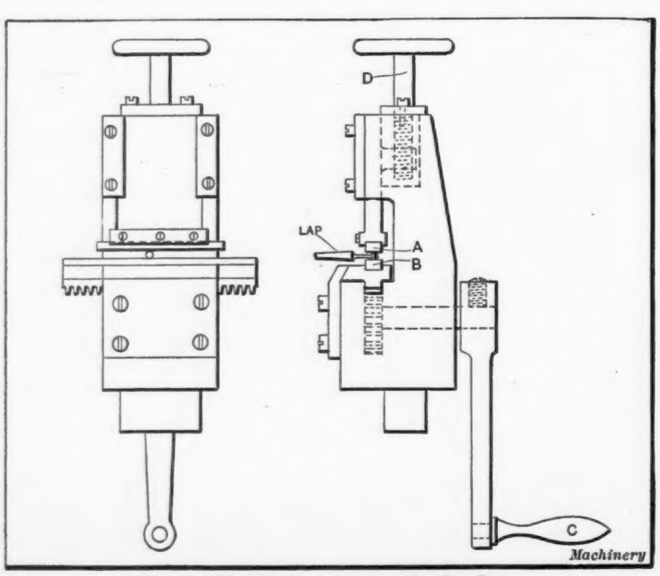


Fig. 2. Machine for charging Circular Laps

At *C* is shown a similar lap with three grinding points *d*, *e* and *f*. When lapping small holes, use a long piece of steel wire with a taper of about 0.0003 inch to one inch, as it will lap rapidly and effectively. When grinding and lapping do not allow loose diamond on the laps, as it will make holes bell-mouthed. For bearing holes, lap with emery. For combination pins where the taper and straight portions must be true with each other, as shown at *D*, Fig. 1, the use of a stop is very helpful. One stop is used for the taper and the other for the straight part.

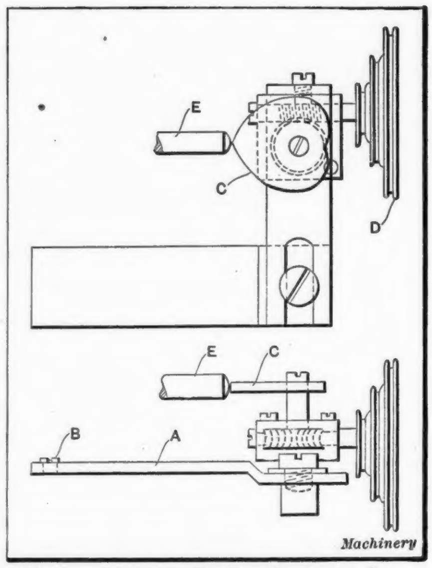


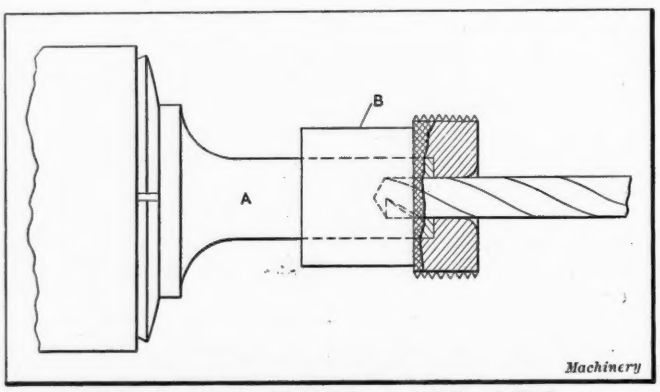
Fig. 3. Automatic Feeding Mechanism for Diamond Lap

When grinding pins on centers, point the ends as shown at *E*, and mount the work between a pair of dead female centers. When regular centers are used, always lap out the holes after hardening to insure their being round. When grinding long slender pins, the work should be steadied in the middle.

Elgin, Ill. EBEN LEA

A CENTERING BUSHING

A simple device for centering rough work in the hand turret lathe is that illustrated in the accompanying line engraving. It is only intended for use in manufacturing small lots of work where more complicated methods would be too expensive. The work is indicated at *A*, and assuming that a hole is to be drilled from the end, the drill is started by slipping the centering bushing *B* over the end of the work, either



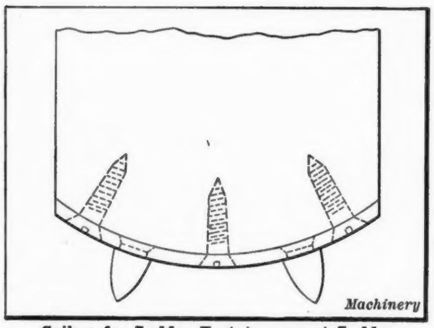
Centering a Drill with Relation to Outside of Work

after rough-milling or before. With this bushing in place, the drill may be entered with the surety that it will be in the center of the work even though the piece is not held exactly true in the chuck. After the drill has been started, the slip bushing *B* is removed and the drilling carried on independently. The purpose of the centering bushing is to provide a means for starting a drill in the center of the work, without first having to make the work run exactly true.

C. L. L.

SPIKES ON LADDER FEET

An article discussing the subject of spikes on ladder feet was published in the November, 1913, number. This was of considerable interest to the writer, so he took up the problem and after studying it for some time decided to use a different class of spike from those described in the article referred to. The only objection to the type of spikes formerly described, is that they might prove somewhat dan-



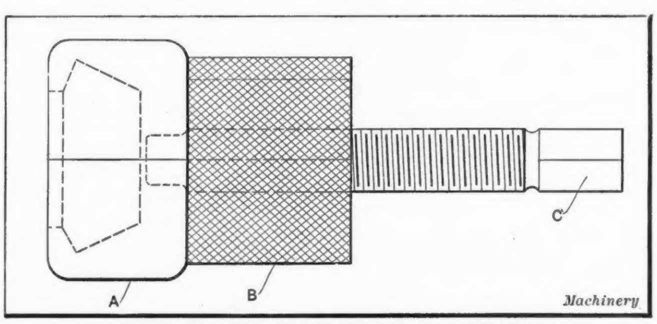
Spikes for Ladder Feet to prevent Ladder from slipping

gerous on account of their length. The probability of letting the ladder down on your foot is not great, although it is quite possible that such a thing may happen, and with long spikes a more or less serious accident would be the probable result. It was on this account that the writer decided to adopt the form of spikes shown in the accompanying illustration. These are only one-half inch long and are made of 3/8 inch round steel riveted into a plate 1 by 1/8 inch in cross-section, which is secured to the foot of the ladder by three screws. The position of these short spikes makes them as effective as longer spikes placed at the center of the foot of the ladder. Experience has shown that a perfectly firm grip on a wooden floor is secured, and yet the spikes project such a short distance that they can scarcely do any serious damage to the man handling the ladder, no matter how careless he may be.

Christchurch, New Zealand JOHN PEDDIE

PULLING SMALL BEVEL GEARS OFF SHAFTS

The accompanying illustration shows a handy device for removing small bevel gears from shafts on which they are a pressed fit. The body *A* of the tool is made in two parts which are recessed to fit over the gear to be removed. The knurled bushing *B* holds the two parts of the body *A* together, and each half of the body is threaded to form a seat for the driving screw *C*. The split body *A* can thus be placed over the gear, after which the bushing *B* is slipped on to hold the two halves of the body together. Then by turning the screw *C* so that its end presses against the end of the shaft, the gear is easily pulled off. The split construc-



Device for pulling Small Bevel Gears off Shafts

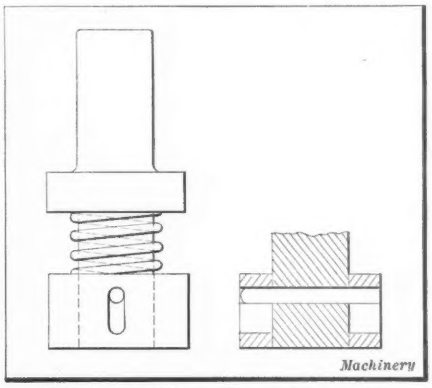
tion also affords a simple means of allowing the screw *C* to be set to approximately the required position at the same time as the two halves of the body are placed over the gear, thus avoiding loss of time in turning the screw in the nut.

M. W. W.

METHOD OF MAKING SLEEVE-RETAINING PINS

Sleeves similar to the one shown in the accompanying illustration are used in punch press departments for stripping work from the punches, the sleeve being actuated by a suitable spring. When such a sleeve is used on a piercing or sizing punch, a pin is driven into a hole in the punch. An elongated hole is provided in the sleeve, so that the sleeve has the required amount of play in either direction before its movement is checked by the pin. It frequently happens that the ends of these pins are made exactly the same shape, and as the pin is slightly tapered this makes it difficult for the tool setter to know which way the pin must be driven in order to remove it, when it is necessary to take off the sleeve to sharpen the punch. The best way to remove the pin is to place the punch end-wise in a vise, so that the sleeve is pushed up from the pin, thus relieving it of the spring pressure. The pin can then be easily driven out.

The writer has found that a convenient way of overcoming the difficulty in regard to which way to drive out the pin is to make the small end of the pin rounding, this end being left a trifle under the outer surface of the sleeve. The pin is hardened and drawn to a blue color. Its length is such that when the flat end of the pin is driven down flush with the sleeve, the rounded end is just below the surface, as previously mentioned. The pin should be driven in from the end at which the hole was started, as the hole is slightly larger at this end than it is at the end where the drill came through. Where these pins are used, it is a good plan to supply the tool setter with a set of various sizes of hardened pins which he can use to advantage in driving out pins of this kind. The ends of the pin do not become flattened after repeated use, as the pin is hardened to avoid this difficulty. This method of making pins can also be used to advantage in various other classes of work where it is occasionally necessary to remove the pins.



Method of making a Sleeve-retaining Pin which shows the Proper End to knock out

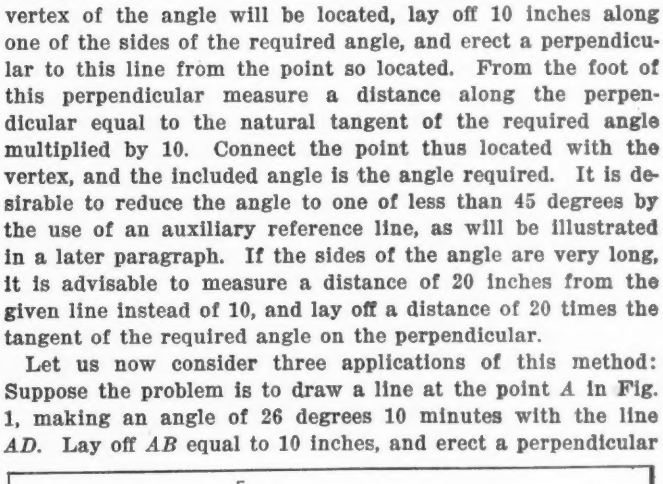
Waterbury, Conn. CHARLES DOESCHER

ACCURATE METHOD OF LAYING OUT ANGLES

The majority of drafting tables are so constructed that it is necessary to use a protractor when an angle is required that cannot be laid out with a 45- or 60-degree triangle. An angle laid out with a protractor is usually inaccurate because the divisions are small and a slight error in the setting is magnified on a long line. It is the purpose of this article to describe an accurate method of obtaining any angle without using a protractor.

By this method, the natural tangent of the angle is employed instead of the angle itself. As a table of natural tangents is available in every drafting-room, there is really no reason why this method should not come into general use. The procedure is as follows: From the point at which the vertex of the angle will be located, lay off 10 inches along one of the sides of the required angle, and erect a perpendicular to this line from the point so located. From the foot of this perpendicular measure a distance along the perpendicular equal to the natural tangent of the required angle multiplied by 10. Connect the point thus located with the vertex, and the included angle is the angle required. It is desirable to reduce the angle to one of less than 45 degrees by the use of an auxiliary reference line, as will be illustrated in a later paragraph. If the sides of the angle are very long, it is advisable to measure a distance of 20 inches from the given line instead of 10, and lay off a distance of 20 times the tangent of the required angle on the perpendicular.

Let us now consider three applications of this method: Suppose the problem is to draw a line at the point *A* in Fig. 1, making an angle of 26 degrees 10 minutes with the line *AD*. Lay off *AB* equal to 10 inches, and erect a perpendicular



Figs. 1 to 3. Three Methods of laying out Angles

BE at the point *B*. Ten times the tangent of 26 degrees 10 minutes equals 4.91. Lay off 4.91 inches on *BE;* this is the distance *BC*. Then connect the points *A* and *C* and the angle *BAC* is 26 degrees 10 minutes.

As the tangent of an angle increases rapidly as the angle approaches 90 degrees, it is advisable to modify the procedure slightly for angles larger than 45 degrees. Let us draw a line making an angle of 78 degrees 30 minutes with the line *AD* at the point *A* in Fig. 2. Erect a perpendicular *AE* at the point *A* and lay off *AB* equal to 10 inches. Subtract 78 degrees 30 minutes from 90 degrees, giving 11 degrees 30 minutes. At the point *B* erect a perpendicular and on this perpendicular lay off *BC* equal to ten times the tangent of 11 degrees 30 minutes, which is 2.034. Connect the points *A* and *C;* then the angle *CAD* is 78 degrees 30 minutes, as required. This method is applicable to angles between 45 and 135 degrees.

For angles greater than 135 degrees it is desirable to use the supplement of the angle. Let us draw a line making an angle of 160 degrees 40 minutes with the line *AD* in Fig. 3. At the point *A* lay off *AB* equal to 10 inches. Next subtract 160 degrees 40 minutes from 180 degrees to find the supplement of the required angle. This is 19 degrees 20 minutes. Erect a perpendicular to *AB* at the point *B* and lay off *BC* equal to 3.51 inches, which is ten times the tangent of 19 degrees 20 minutes. Connect the points *A* and *C*, and the angle *CAD* is the required angle of 160 degrees 40 minutes. This method is commended for angles between 135 and 225 degrees.

Newark, N. J. H. A. FREEMAN

PLANING A BLOCK SQUARE

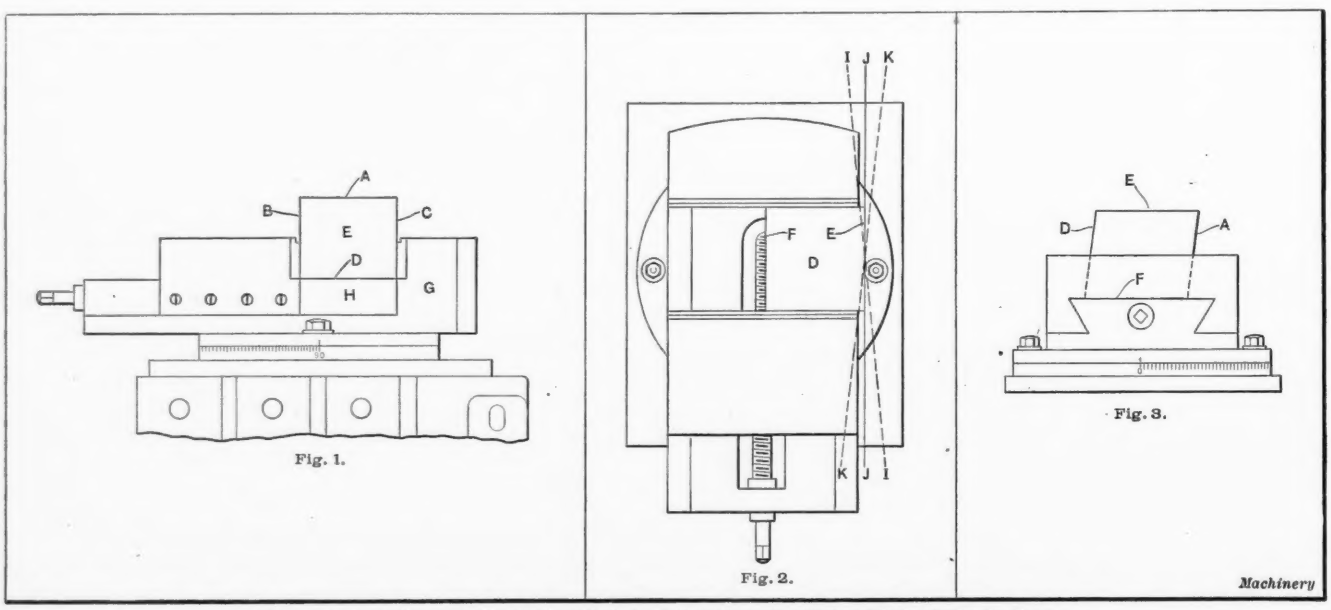
When most apprentices are given their first die-block to plane, they simply set it up in the shaper vise and plane side after side until all of the sides are finished. The result is a block with six rhomboidal sides, not one of which is square with another. As the apprentice is the mechanic of the next generation and as he frequently completes his time without learning the proper way of doing this work, the result is that many machinists follow the same method of procedure and produce decidedly unsatisfactory results.

The first and most important point to observe in planing a block of this kind is to plane the widest surface first. A wide, flat block should always have the widest face planed first. When the block is nearly cubical in form this is not so important, although it is always the best plan because it gets one into the habit of doing the work right. A brief explanation in connection with the accompanying illustrations will prove of assistance in showing what to do after the first surface has been planed. Let *A, B, C, D, E* and *F* represent the six sides of a block, and the letters *G* and *H* represent the fixed jaw and the base of the shaper vise.

The method of procedure is as follows: With the block set centrally in the vise as illustrated in Fig. 1, plane side *A;* then present this side to the fixed jaw *G* and plane side *B*. Next set the block with side *A* against the jaw *G* and side *B* in contact with the base *H* of the vise, and plane side *C*. Then set the block with side *A* in contact with the base *H* and plane side *D*. This leaves only the sides *E* and *F* to be finished. Fig. 3 gives an exaggerated idea of the wrong way to plane these sides, for if the side *E* is finished in this manner, the side *F* not being square with the sides *A* and *D*, the block will not be accurate.

The proper way to plane the sides *E* and *F* is illustrated in Fig. 2. The block is set up in the same position that it occupied when the side *D* was planed, except that instead of being central between the jaws, it is brought over so that the side *E* will project so that it can be planed down. If the graduations on the swivel of the vise are inaccurate to such an extent that the jaws will not be at right angles with the stroke of the shaper ram, this may be corrected as shown by the lines *I, J* and *K* in Fig. 2, which represent strokes of the shaper ram. If with the side *A* in contact with the base *H* of the vise, the stroke of the shaper planes side *E* as indicated by the line *K*, by completely turning the block over so that the side *D* is in contact with the base *H*, another line of action will be formed at *K* owing to the inaccuracy of the swivel; but the original line *K* will occupy the position shown at *I*. By changing the swivel until both lines coincide as shown at *J*, this error is eliminated. In order to determine the coincidence of the lines *J*, an intermediate or connecting line must be made on the side *B* or *C*, at the time that the block is turned over. When this result has been obtained, side *E* is planed, after which the block is turned over and set up to plane the side *F*. When this method is followed a perfect die-block or box-jig will be produced.

Stonington, Conn. M. T. LEAHY



Figs. 1 to 3. Diagrams illustrating Method of Procedure in planing Block absolutely Square

INDEXING ATTACHMENTS FOR RACK MILLING

I have frequently been interested in reading descriptions of various methods for cutting racks on the milling machine, but have never seen a table published which gives the necessary data for cutting accurate racks of various diametral pitches. The usual tables are merely approximate for the required circular pitch, and while these do very well for the average classes of work, they are useless where absolute accuracy is required. I recently had to cut a rack for use on a dividing machine and for handling this work it was necessary to devise an accurate method. In preparing for this job, I compiled the table published in connection with this article, which gives the settings for use in cutting all diametral pitches from 3 to 48.

MILLING MACHINE SETTINGS FOR CUTTING ACCURATE RACK TEETH

Diametral Pitch	Circular Pitch, Inches	Gear on Screw	Gear on Locking Disk	Angle	
				Degrees	Minutes
3	1.0472	26	109	2	21
$3\frac{1}{2}$	0.8976	20	72	4	11
4	0.7854	21	66	1	37
5	0.6283	34	86	6	29
6	0.5236	38	80	5	50
7	0.4488	36	65	6	8
8	0.3927	42	66	1	36
9	0.3491	40	56	4	7
10	0.3142	50	63	4	5
11	0.2856	49	56	1	36
12	0.2618	62	65	2	43
13	0.2417	49	48	9	16
14	0.2244	72	65	6	9
15	0.2094	50	42	4	20
16	0.1964	62	49	6	16
18	0.1745	50	35	4	20
20	0.1571	63	40	8	13
22	0.1428	52	30	8	4
24	0.1309	51	27	8	29
26	0.1208	90	44	8	5
28	0.1122	75	34	8	7
30	0.1047	100	42	4	20
32	0.0982	86	34	6	30
36	0.0873	90	32	10	51
40	0.0785	75	24	11	7
48	0 0655	90	24	10	44

Machinery

In order to explain the use of this table (in handling the work on a universal milling machine) let us suppose that a rack is required with 30 teeth of 16 diametral pitch, or 0.19635 inch circular pitch.

$30 \times 0.19635 = 5.8905$ inches = length of thirty teeth.

The most suitable change gears available for this purpose were wheels with 48 and 60 teeth, respectively. Placing the 48-tooth gear on the table screw and the 60-tooth gear on the locking disk, and revolving the latter thirty times, gives a table traverse of 6.000 inches, which is too long by 0.1095 inch

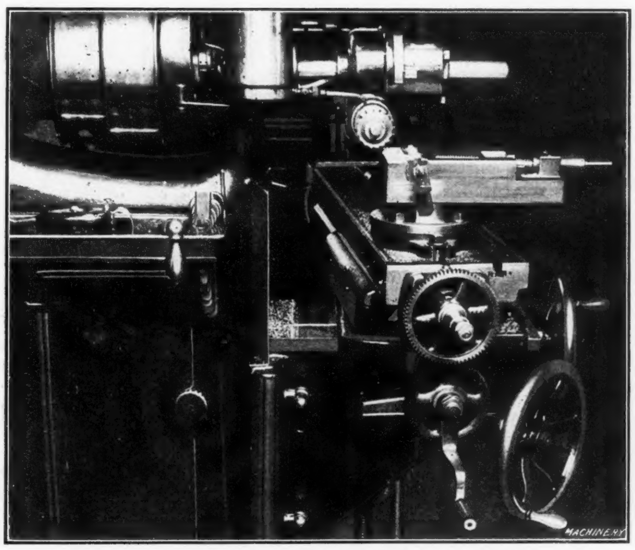


Fig. 1. Universal Milling Machine Attachment for Use in cutting Accurate Racks

or 0.00365 inch per tooth. The work is held in a swivel vise, and to correct for this error in the table traverse, the milling machine table is first swung to the angle given in the table for a 16-diametral pitch rack, after which the vise is swung through a corresponding angle in the opposite direction; *i. e.*, 6 degrees 16 minutes, which brings the work back at right angles with the arbor. After completing this setting, if the locking disk is rotated thirty times, it will be found that the traverse amounts to exactly 5.8905 inches, which is the required distance for cutting thirty teeth of 16 diametral pitch. The same is found true of all pitches given in the table.

A brief consideration of this method of setting will make it clear. When the table is set at an angle, the traverse obtained by the gearing, multiplied by the cosine of the angle at which the table is set, gives the traverse of the work on a line at right angles to the spindle. One of the features of this attachment is that it may be easily fastened to the table of any universal milling machine. Referring to the illustration, it will be seen that the attachment consists of a bracket fastened to one end of the table, and that the table is entirely unobstructed. The locking disk is grooved to receive a round pin, and is attached to an adjustable stud on the bracket; the handle which revolves the disk is mounted on the same stud. The pin enters the groove in the disk and helps the operator in keeping accurate account of the number of revolutions.

EBRANE

[The writer states that his table was compiled owing to inability to find a table of milling machine settings for cutting accurate rack teeth. Had he referred to the index table for the rack cutting indexing attachment for the Brown & Sharpe milling machine, he would have found a very satisfactory reference for this purpose. The error of the teeth

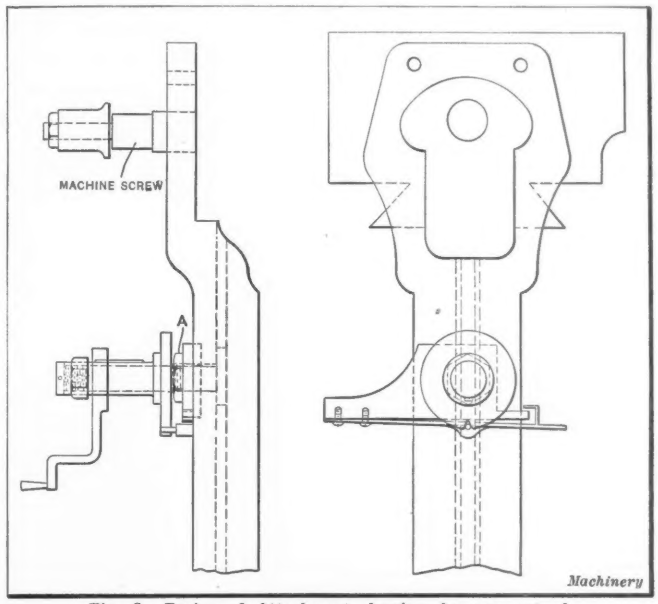
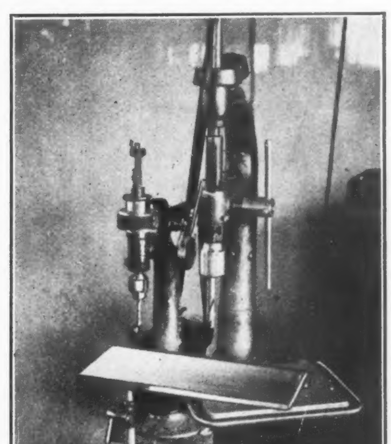


Fig. 2. Design of Attachment showing Arrangement of Locking Disk and Pin

cut with this attachment, and using the settings in the table referred to, amounts to only from 0.0001 to 0.0004 inch.—EDITOR.]

MULTIPLE DRILLING WITH A SINGLE SPINDLE MACHINE

It was required to drill and ream two holes in several thousand castings, one of the holes being 3/16 inch in diameter by 1/4 inch long and the other 7/16 inch in diameter by 1 inch long. Of course a jig was made to secure rapid and accurate production, but it was foreseen that at the time when the castings would be ready the only machine available would be a single-spindle sensitive drill press. The use of this machine would mean four chuckings of each piece and tying up the machine for a long time.

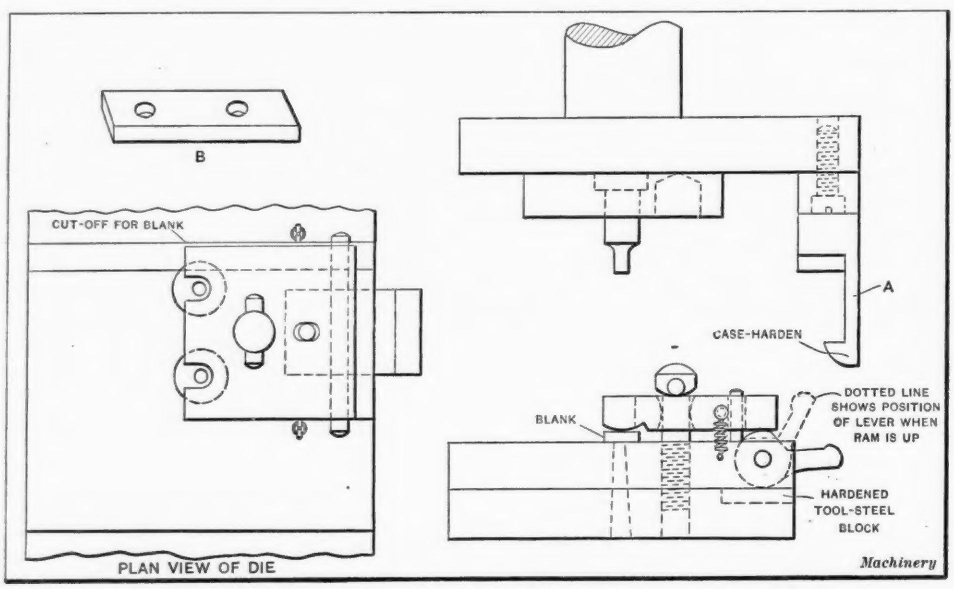


Setting up a Bench Drill on a Single Spindle Drill Press for Multiple Work

The writer finally hit upon the following scheme. A light bench drill was available and this machine was mounted at the side of the larger drill press and used for drilling and reaming the 3/16-

inch hole. To do this, an auxiliary table was made for the drill press; the surface of this table was accurately planed, after which it was bored and split to fit onto the column of the larger machine. A second hole was bored part way through the auxiliary table to receive the base of the bench drill and locate it in the desired position. The auxiliary table was then adjusted to such a height on the column of the drill press that the tables of the two machines were exactly level. The arrangement will be readily understood from the illustration, where it also will be noticed that a planed iron plate was provided to afford an unbroken surface for the jig to rest upon.

The entire lot of castings was first drilled. Reamers were then put in the machines and the holes finished. Two holes were drilled and two holes were also reamed at each setting of the work. Finished spots on the castings made it possible to relocate the work rapidly and accurately. The rate of production secured by this method was all that could be desired, and the method made it possible to handle the work without congestion or tying up any of the machines in the shop for a long period of time. In addition, the auxiliary table is now available for other classes of work that may come up in future and that can be handled in the same way.



Attachment on Die to prevent springing of Thick Stock when punching Holes

The photograph from which the illustration was made may prove of interest to those who have wished for some satisfactory background for use in shop photography. This photograph was taken with an inexpensive camera, the time of exposure being two minutes. The background used consisted of a piece of canvas three feet square which was moved up and down and across directly behind the machine that was being photographed. The writer operated the camera and also the background. As soon as the shutter was opened, he grabbed the canvas and proceeded to move it around behind the machine, dropping it in time to close the shutter. This is a simple and inexpensive method of screening off a machine for photographing and is much less expensive than setting up a large screen.

Middletown, N. Y. D. A. HAMPSON

PUNCHING HOLES IN THICK STOCK

When punching holes in stock say 3/16 inch thick or greater, the stock tends to curl due to the pressure of the punches being localized. This is especially true when the holes are to be nearly straight through, as this necessitates a somewhat closer fit between the punch and die than is good practice. With proper clearance, or rather, with customary clearance, between punch and die, the holes punched are, at the upper surface, a trifle larger in diameter than the punch; the hole gradually tapers to a diameter as large as the die and sometimes the stock breaks and the punching is actually larger than the die. This causes disastrous results unless the die has a wall heavy enough to withstand the pressure required to force the over-sized punching through it.

The accompanying illustration shows a very good method of eliminating the springing of the blank. This scheme can also be employed to hold various blanks while performing bending operations. As will be noted the clamping and releasing mechanism is actuated by the arm *A*. Assume that a blank is desired as shown at *B* and that the holes in this blank must be nearly straight. If an ordinary piercing and cutting-off die were employed, the blanks would receive a "set" directly around each pierced hole, causing the blank to curl. This results in many broken punches, especially if the stripper happens to be on a slight angle with the plane of the die. This set is caused by the stock surrounding the punches being free to move, and it is obvious that if stock is rigidly held in contact with a level die surface, although the same pressure of the punches is exerted on a blank, there will be very little curl due to the inability of the stock to receive the set which holds the blank in a curved position. What is meant by the term "set," will be more apparent if we consider a piece of steel gripped in a vise. We can bend the steel back and forth for a short distance only, *i. e.*, inside the elasticity limit and the steel will return to the same position each time, but if we bend steel a trifle too far it receives a permanent set and remains fixed.

This clamping device will be found excellent when used in conjunction with forming operations. Every diemaker aims to have the die at hand perform as many operations at each stroke as is consistent with good practice and without making the cost of the die prohibitive. A spring pad on the punch is often employed (equipped with very stiff springs), the pad producing one or more forming operations; as the ram of the press continues to descend the spring pad recedes and the forming punch performs its function. But when the stock is heavy the spring-pad scheme is out of the question. By keeping the method shown in the illustration in mind, the diemaker will find many opportunities for its use both in forming and blanking operations.

Detroit, Mich. F. E. SHAILOR

* * *

A new process of producing fuel from coal dust, lignite, peat, sawdust, etc., has been patented by the Societe Houillere du Nord d'Alais of France. It consists, according to the *Echo des Mines et de Metallurgie*, in mixing with the small material a colloidal substance such as the starches or the flour resulting from the grinding of rice, etc. The mixture thus obtained is compressed and the resulting briquettes submitted to an intensive drying, which hardens them and renders them capable of withstanding the action of water for a long time without disintegration. As an example the following is given: Dry ground rice in the proportion of 2½ per cent by weight is mixed with 97½ per cent of anthracite dust; hot water or steam is injected into the mixture in order to transform the flour into a pasty mass, which is kneaded before passing into the press. The briquettes are then dried three or four hours at 200 to 400 degrees F.

* * *

It is stated on the authority of the *Birmingham Daily Post* that during the Liége bombardment the Germans destroyed the Ougrée-Marihaye Steel Works near Liége, and also partly demolished the Cockerill works at Seraing. The Cockerill works employed 10,000 men and among other lines have won great fame in the manufacture of armor plate and fortification material. The Ougrée-Marihaye Steel Works employed 12,000 men.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW DESIGNS AND IMPROVEMENTS IN AMERICAN METAL-WORKING MACHINERY AND TOOLS

H. P. TOWNSEND AUTOMATIC SCREW MACHINES

The development of the automatic screw machines described in the following, for working on headed blanks that are fed to the machine from a hopper, has been made possible by the progress which has been made in cold-heading. When it is necessary to turn blanks to form the heads, the amount of material wasted is frequently greater than that retained in the product, thus making the cost of material excessively high. The use of headed blanks avoids this waste, and those who have had experience with cold-heading, find that it may be applied for producing work of innumerable forms, and that the results obtained are highly satisfactory.

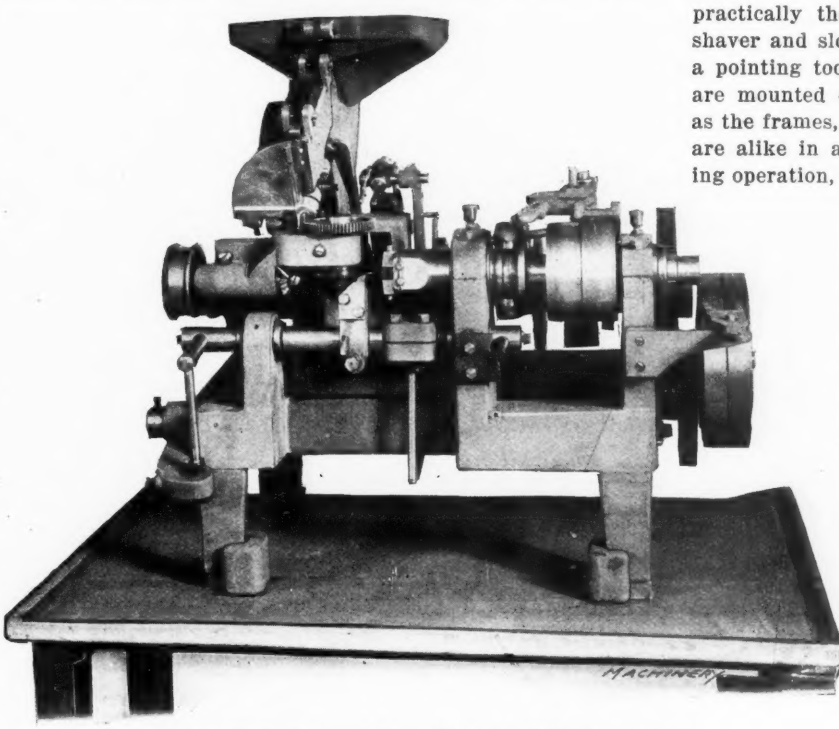


Fig. 1. H. P. Townsend Screw Shaving and Slotting Machine

Primarily, the machines are intended for manufacturing common gimlet point wood-screws. In making wood-screws, after the blanks have been made in a heading machine, the first machine to be used is for shaving and slotting the heads; and the second machine is for pointing and threading. The shaver and slotter shown in Fig. 1, unlike those now in use, has only one spindle which revolves for the turning or shaving of the head and stops automatically when this operation is completed; it is locked rigidly in position while the sawing operation takes place. After this, the spindle starts again and the turning tool is again presented to the head to take off the burr left by the saw. It will be noticed that this machine is provided with a tool-bar which rocks the tool against the work for ordinary turning operations. This tool-bar and its operating levers are known as the turning mechanism and can be used in connection with or independently of the sawing mechanism; or the sawing mechanism may be used independently of the turning mechanism, so that this machine, in itself, can be used as a shaver and slotter, for plain shaving or for plain slotting.

The second machine used in making wood-screws is the pointer and threader illustrated in Fig. 2. In this machine practically the same turning mechanism is used as in the shaver and slotter, and the sawing mechanism is replaced by a pointing tool. Both the saw mechanism and pointing tool are mounted on the same bearing and can be interchanged, as the frames, spindles, back-rest bracket, and feed mechanism are alike in all of the machines in the line. In the threading operation, the tool-bar not only feeds in to secure the depth of cut, but it reciprocates longitudinally at the proper speed for cutting threads of any desired pitch, passing over the screw as many times as required. It will be noticed that in this machine the turning mechanism is adapted to move sideways and therefore constitutes a threading or turning mechanism, plain turning being done in the same manner as on an ordinary lathe. The pointing mechanism, being independent of the threading mechanism, can be used for plain pointing, omitting the threading operation, or the threading mechanism can be utilized for plain threading or turning, omitting the pointing mechanism, so that this machine also constitutes three separate machines: for pointing and threading, plain pointing and plain turning, and plain turning or threading. A drilling attachment is also provided, which can be applied to the frame without changing the general mechanism, and this drilling attachment can be used alone, in combination with either the plain form turning device or with the threading or longitudinal device, so that one machine can be used for plain drilling, or it can be conveniently made into a combination forming and drilling machine or a combination drilling and

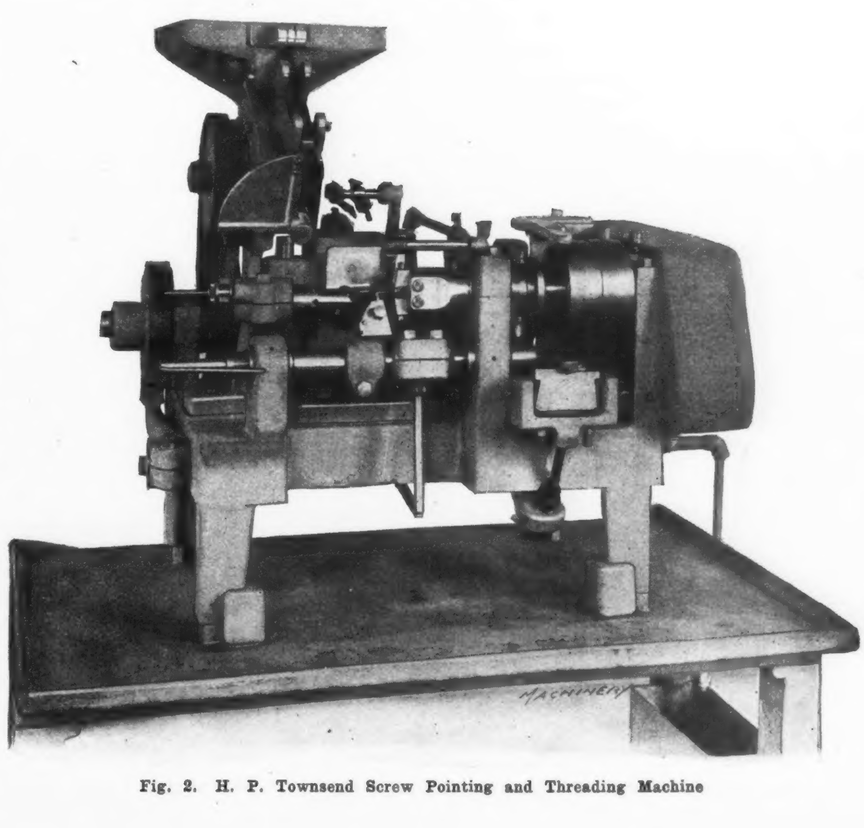


Fig. 2. H. P. Townsend Screw Pointing and Threading Machine

threading machine. This attachment is shown in Fig. 3.

The drill mechanism, by a slight change in the spindle and in the spindle operating levers, forms a tapping or die threading device, the levers being adapted to start and stop the tapping spindle. This device can be used alone or if the operation is to be that of tapping, it can be combined with the forming mechanism, which gives possibilities on the same machine of plain tapping or die threading and combined tapping and forming. This application is shown in Fig. 4. The general construction and appearance of these machines is very much alike, so that one operator can easily understand all of the different machines. By leaving off the feed mechanism and applying a rod feed to the spindle, the machine can be utilized for turning, drilling and cutting off small pins, studs, etc. In all these machines the spindle revolves. In another application of the saw mechanism for plain slotting, the spindle does not revolve and on this machine it is possible to use two saws on the saw spindle for flatting or slabbing off two sides of a blank; also, an index device can be applied for indexing the spindle 90 degrees so that the saws may be brought up to flatten two sides of the blank and then withdrawn while the spindle is turned 90 degrees and the saws are again brought into action, forming a square on the blank. This index may also be used to mill a hexagon shape. The machine illustrated in Fig. 5 is equipped in this way.

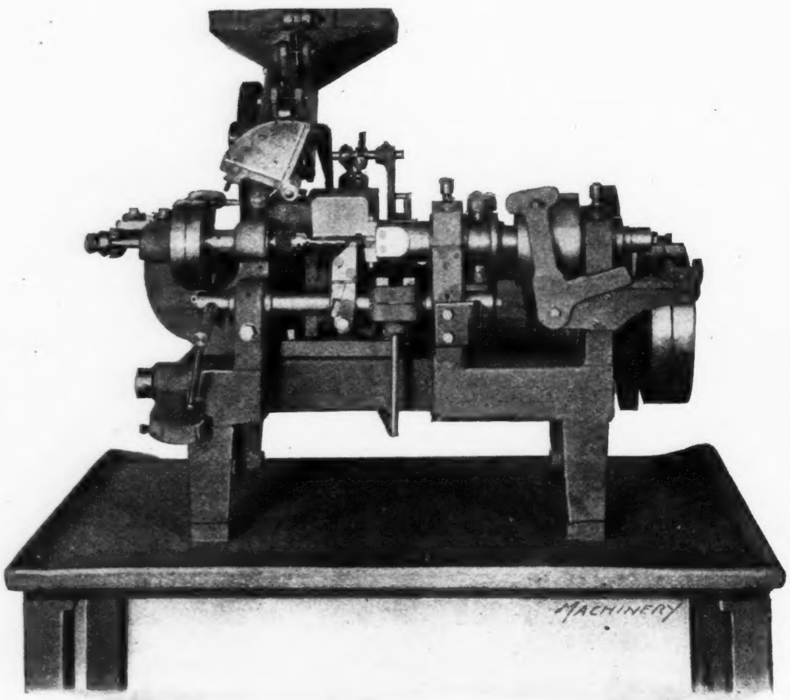


Fig. 3. Townsend Screw Machine tooled up for Drilling and Turning Operations

In all the machines, the feed mechanism can be changed to feed the blanks either point first or head first so that all of the operations can be performed on either end of a blank. These machines can be provided with pans, legs, and an oil system so that they may be used singly or in a battery, as desired. Unlike the machines of this class now in use, they drive from overhead, keeping the belts free from grease and leaving the under side of the machine clear for storage. An innovation on this type of machine is the tight and loose pulley on the spindle, with the belt shifter which enables the operator to conveniently turn the machine by power when trying out the tools, thus starting and stopping at will. Where it is possible, the machines are provided with an interlocking belt shifting mechanism so that the machine cannot be started unless the spindle is revolving, thereby preventing the breakage of tools, which would be the case if the spindle were not turning so that the tools could perform their cutting functions. All the adjustments on the machines are directly in front, where the operator can easily reach them. This is an especially valuable feature in the shaving and slotting machine which, in the old type in common use, has the saw mechanism on the back so that the operator has to walk around the line of machines in making adjustments.

A peculiar and valuable feature in connection with the saw mechanism is an arrangement for compensating for irregularities in the saw. This arrangement causes the saw to cut all the way around instead of just on the high teeth. This same arrangement prevents the breakage of saws to a great extent by allowing any tooth which catches or clogs to relieve itself before it will break. Usually the saws will get dull instead of breaking. Fig. 6 shows a variety of operations that can be performed on headed blanks, the heavy lines showing where the metal has been removed. It will be seen that these machines are not limited to standard screws but

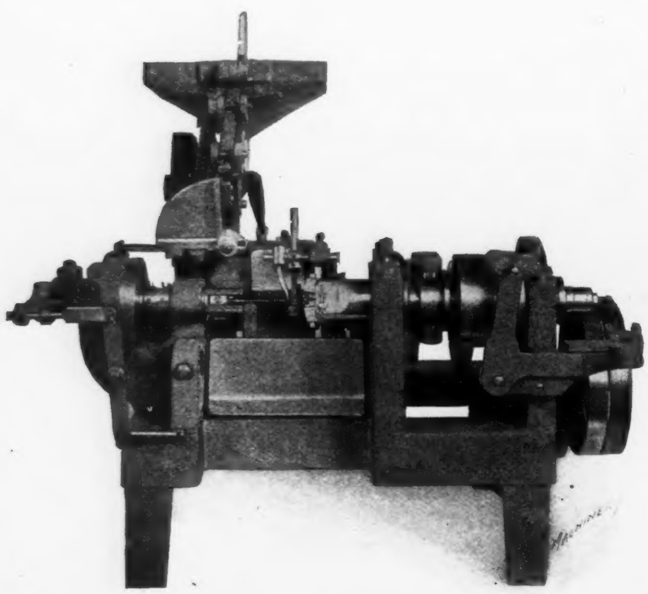


Fig. 4. Machine equipped for handling Tapping Operations

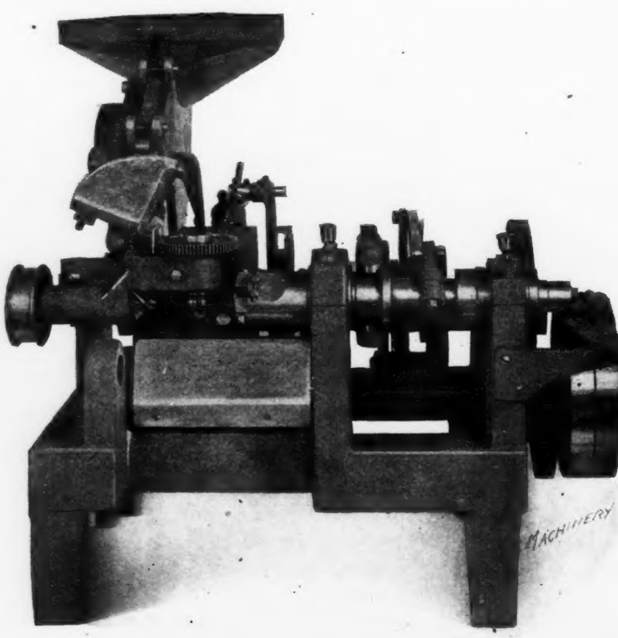


Fig. 5. Application of Two Saws for Squaring Operations

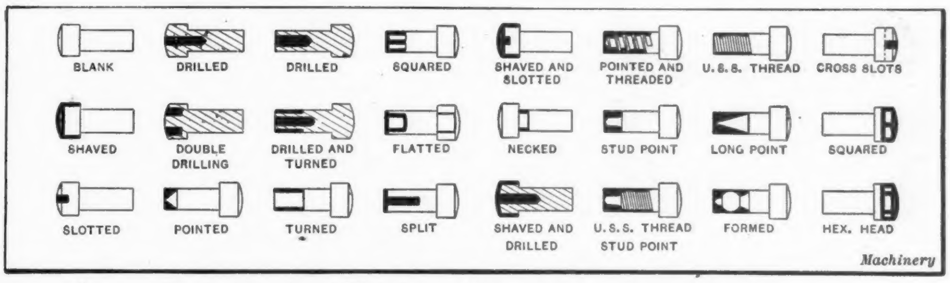


Fig. 6. Examples of Work done on Townsend Automatic Screw Machine

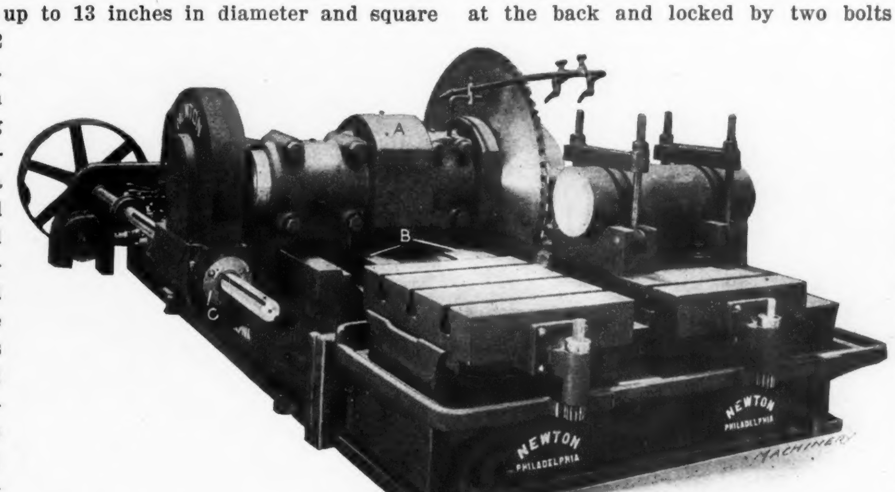
are capable of performing any kind of metal cutting operation on either end of any blank that can be fed from a hopper. The feed mechanism is novel in its construction and it is possible to feed many blanks which cannot be fed in any other hopper feed mechanism; one notable record it achieved was continuous running for thirty-two hours without missing a blank. The machines are useful in performing secondary operations on numerous screw machine parts as well as on blanks which have been headed from wire. These machines have recently been placed on the market by the H. P. Townsend Mfg. Co., Hartford, Conn.

NEWTON COLD SAW

The accompanying illustration shows a cold metal saw which constitutes a recent addition to the line of machines built by the Newton Machine Tool Works, Inc., Philadelphia, Pa. One of the important features of this machine is the entirely enclosed driving spindle gear and pinion which provides for the operation of these members in grease; the gear case is shown at *A*. Another feature of the machine consists of the incorporation of narrow guide bearings *B* which decrease the friction between the saddle and ways to a minimum. The adjustable thrust bearing *C* with auxiliary bushings to prevent the escape of oil and to preserve the fixed bushings from contact with the splines, is another noteworthy point in the construction. Care has been taken to limit the overhang of the saw blade beyond the shears to a minimum.

It will be seen that the machine is provided with duplicate work-tables which can be adjusted independently or in unison as desired. Both V- and arch-clamps are provided for holding the work. The spindle is extended and fitted with spacing washers which enable any desired distance to be obtained between the saw blades when two blades are used at the same time. This distance between the blades can be adjusted by increments of 1/8 inch. The spindle is supported at both ends and revolves in bronze bushed capped bearings. The teeth of the driving pinion are cut from the solid shaft and the driving worm-wheel is cut from a solid bronze casting. The feed is obtained from a gear-box which affords six changes without the removal of gears, and the saddle has fast power traverse in both directions. Adjustable and safety release is provided for all motions in the extreme positions.

The machine may be equipped with either one or two saw blades 44 inches in diameter, which gives a capacity for cutting through oblong billets 20 inches high by 10 inches wide. Round stock up to 13 inches in diameter and square stock up to 12 by 12 inches can be cut. Larger sections can be cut by turning the stock. The illustration shows a machine equipped with one blade and with the spindle extended out beyond this blade. Where a second blade is used, it is mounted on this spindle extension, the two blades being used for working simultaneously on such pieces as open-end locomotive rods, etc. This cold saw is of exceptionally heavy construction and is particularly adapted for handling heavy forge work and other classes of work where a machine of unusually heavy construction is required.



Newton Cold Saw designed for handling Heavy Forge Work

AMERICAN ELECTRIC GRINDER

The American Electric Grinder Co., Chicago, Ill., is the manufacturer of the self-contained, double-end, motor-driven grinder which forms the subject of this article. This machine is particularly adapted for heavy classes of foundry grinding and similar work. The important feature of the construction lies in the fact that the motor is built around the grinding wheel shaft, the arrangement being such that repairs to the motor may be made without requiring the machine to be dismantled. To provide the maximum rigidity, the base of the grinder from the center of the wheel spindle down is a single heavy casting, and the spindle is made from 35 to 40 point carbon steel and ground accurately to size. In the standard machines, the spindle is mounted in Hyatt roller bearings, but ball bearings may be substituted if desired.

Fig. 1 shows a general view of the machine and Fig. 2 shows the arrangement of the motor drive in some detail. The motor armature is assembled on a spider, through which the wheel spindle is forced at 500 pounds pressure. Should it become necessary to re-wind or repair the armature, it is not necessary to remove the armature from the machine. For this purpose, the upper half of the field ring *A* is in the form of a separate casting hinged to the base, and may be raised to the position shown, in order to give access to the armature. The lower half of the field ring is cast integral with the base of the grinder. The brush holders *B* and the pole pieces *C*, including the wiring, may be lifted up out of the way, and when this has been done, the armature may easily be repaired without removing it from the machine. The electrical connections are so arranged that they do not have to be broken while working on the armature.

The electrical controlling apparatus used on the machine is provided by the Electric Controller & Mfg. Co., of Cleveland, Ohio. The switchboard is located inside the base of the grinder where it is readily accessible by opening the door shown in Fig. 1. The push buttons *D* are used for starting and stopping the motor and a rheostat is provided for regulating the speed to compensate for the change in size of the wheels, which results from trimming. It will be seen that about three-quarters of the wheels are covered by cast-iron shields, and the outer plate of each of these shields is hinged at the back and locked by two bolts at the front. This enables either plate to be swung back, as shown in Fig. 1, making the replacement of wheels a very easy matter. In addition to covering the wheel, it will be noticed that the guard covers the nut at each end of the spindle so that the possibility of accidents through the operator's clothing becoming caught is eliminated.

The work-rests are made in two pieces

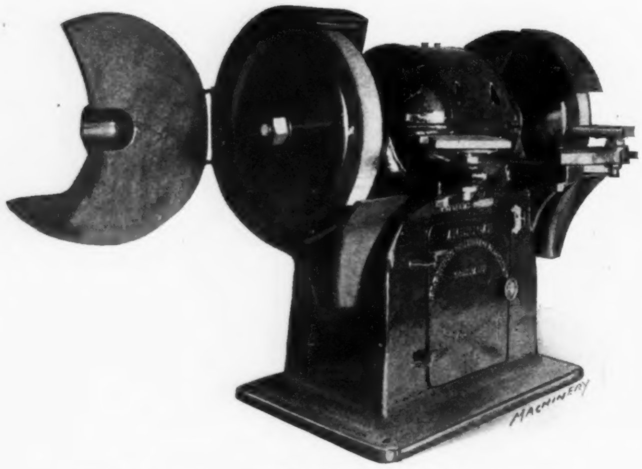


Fig. 1. American Electric Grinder showing Arrangement of Wheel Guards

and bolted together. Whenever the used section of the rest becomes worn, a new plate may be easily bolted to the support, extra plates for this purpose being provided with the machine. The heavy foundry size of this type of grinder requires a 5-

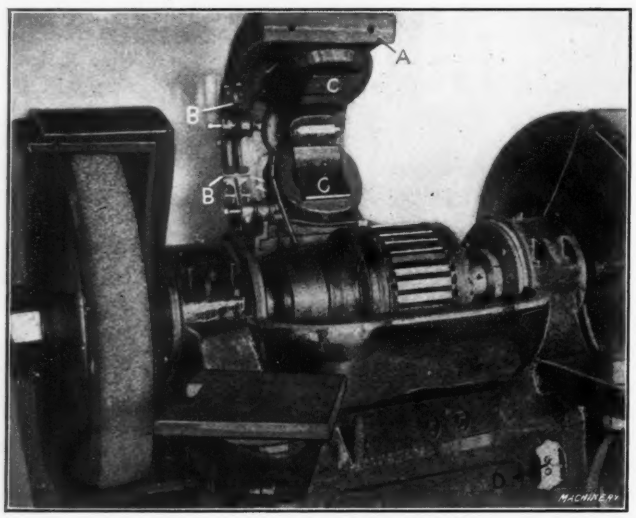


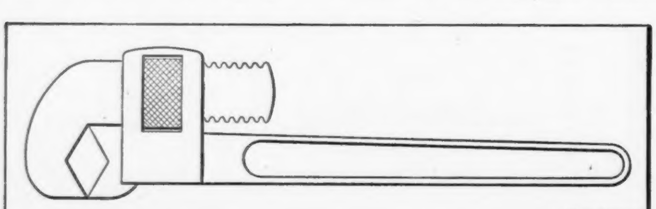
Fig. 2. Arrangement of Driving Motor

horsepower motor to drive it and is suitable for running at from 800 to 1200 revolutions per minute. Wheels 24 inches in diameter by 3 inches face width are used. Without the wheels, this machine has a weight of approximately 2900 pounds. The same type of grinder is also made in several different sizes, the smallest of which carries wheels 10 inches in diameter by 1 inch face width; and the largest, wheels 42 inches in diameter by 6 inches face width.

"WALCO" HEX WRENCH

The "Walco" hex wrench is manufactured by the Walworth Mfg. Co., Boston, Mass., and is particularly adapted for removing valve bonnets and turning other hexagonal parts. Every engineer or user of valves will appreciate the value of this tool. Valve bonnets are made up in a factory where special wrenches are used, and if it becomes necessary for the user to remove a bonnet by means of a monkey wrench or "Stillson" wrench, the hexagons are almost certain to be damaged.

Reference to the illustration will make it evident that the "Walco" hex wrench grips four sides of the hexagon where

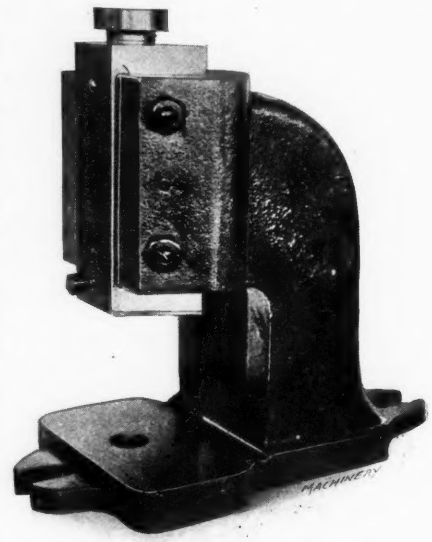


The "Walco" Hex Wrench for Pipe-fitting and General Work

an ordinary monkey wrench only grips two sides. Using this new wrench, it is possible to remove valves or cocks from a pipe line without injuring their finished surfaces. This wrench is made of high-grade tool steel.

OPTICAL TOOL CO.'S SUB-PRESS

The Optical Tool Co., Providence, R. I., has recently brought out a sub-press intended for carrying fine dies that must be kept in permanent alignment. The principal distinction that this press has over others is the shape of the plunger. This, in section, resembles a triangle with the apex cut off. The plunger is made of steel and runs in cast-iron bearings; the adjusting gib is also of cast iron, so that the wearing surfaces are steel to cast iron. With this sub-press there is less chance for extensive wear developing, and adjustments may be made very quickly. The frame of the sub-press is of open construction at the back so that stock may be fed either sideways through the dies or from the back.

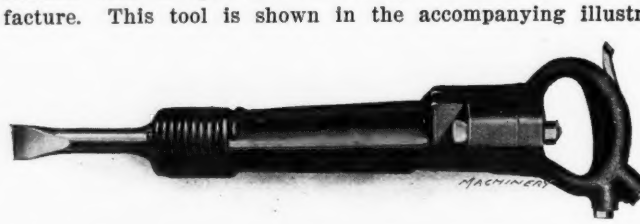


Sub-press for operating Fine Dies that must be kept in Permanent Alignment

"LITTLE DAVID" RIVET "BUSTER"

In making riveted joints it frequently becomes necessary to remove one or more rivets, and for this purpose a hammer and cold chisel are often used to knock off the rivet head. This method is not only slow but may result in damage to the work. A more convenient way is to use a pneumatic chipping hammer. In the case of large rivets a slot is cut through the center of the head, after which a tap with a hammer on each side of the head serves to break off the two halves; the rivet may then be easily driven out of the hole.

As it is not practical to keep a pneumatic chipping hammer on hand for occasional use in removing rivets, the Ingersoll-Rand Co., 11 Broadway, New York City, has recently added to its line the "Little David" rivet "buster" for use in connection with the pneumatic riveting hammers of its manufacture. This tool is shown in the accompanying illustra-



"Little David" Riveter equipped with a Chisel for "busting" Rivets

tion, from which it will be seen that it consists of a chisel which is mounted in the "Little David" riveting hammer, in place of the usual rivet set. The shank of the rivet "buster" is similar to that of the regular rivet set, and is so designed that it is held in place by the safety retaining spring. The rivet "buster" is of a size and shape which enable it to also be used for removing burrs or other defects from the metal. It can be conveniently carried in the workman's pocket where it is always available for use when necessary. The "Little David" riveting hammer was described in the May, 1913, number of MACHINERY, and the rivet set retainer for use on this tool was illustrated and described in the August, 1914, number.

"ACORN" DIE

The Wiley & Russell plant of the Greenfield Tap & Die Corporation, Greenfield, Mass., has recently added to its line what is known as an "Acorn" threading die, which is illustrated herewith. Fig. 1 shows the assembled die-holder ready to be mounted in the machine, while in Fig. 2 the parts of the die-holder and the die are shown arranged in their relative

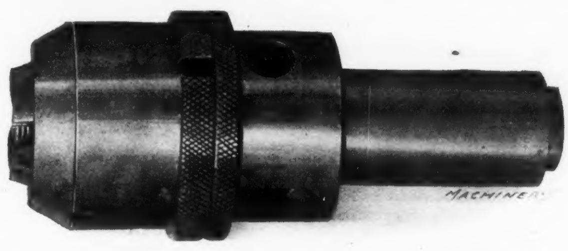


Fig. 1. "Acorn" Die mounted in Holder ready for Use

positions. These illustrations make the construction and operation of the die so clear that only a brief description will be necessary.

Referring to Fig. 2 it will be seen that the die *A* has the four lands contained in a single piece. The cap *B* fits over the die and engages the ground conical surfaces of the lands, affording adequate support to prevent the possibility of deflection, and at the same time providing means of adjustment. After the cap *B* has been screwed up to make the die cut to the required diameter, the lock nut *C* is screwed back tight against the cap to prevent it from turning and the size of the die from changing.

The die *A* is driven by the pins *D* in the face of the die-holder, while this holder, in turn, is driven by the pin *E* which enters the slot in the socket *F*. In assembling the die and holder, the screw *G* is tightened up, thus drawing the pin *E* in the die-holder back into the slot in the socket *F*. This brings the tool to the condition shown in Fig. 1. The cap *B* and collar *C* may then be adjusted in the manner previously described, after which the die is ready for use.

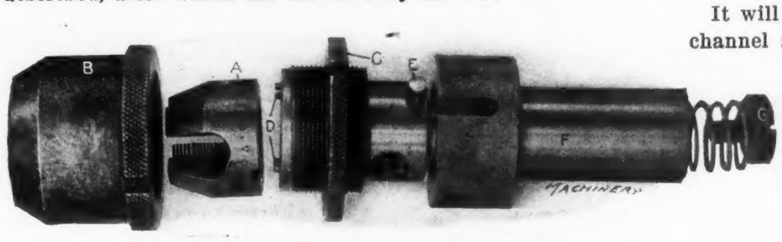


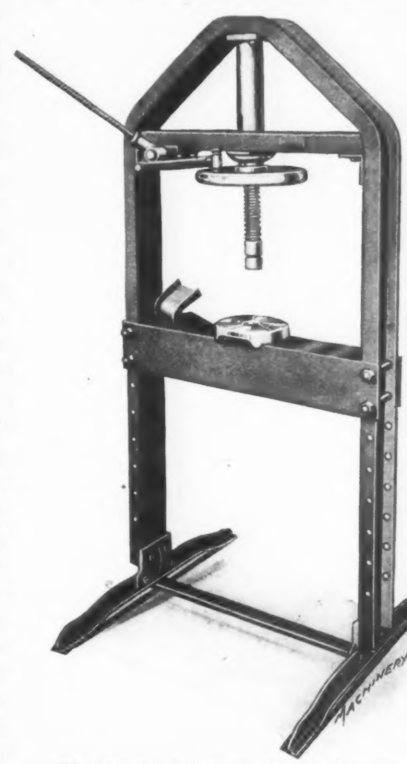
Fig. 2. Parts of "Acorn" Die and Holder in Position for assembling

The noteworthy features of this "Acorn" die are that when it is adjusted the four lands are sure to be moved in an equal distance toward the center, owing to the ground conical surfaces which engage the cap *B;* that the cap *B* affords a positive support for each of the lands; and that the chasers can be sharpened from fifty to one hundred times, provided the workman observes the necessary precaution in grinding them. When the die becomes dull, it is merely necessary to remove one or two thousandths of an inch from the cutting face of each of the four lands of the die. This removes the rounded edges of the lands and exposes a clean sharp cutting edge to the work. The projection of the lands beyond the cap *B* enables the die to cut close up to shoulders without difficulty.

This "Acorn" die and its holder are adaptable for use on all kinds of machines such as lathes, drill presses, hand or automatic screw machines, turret lathes, bolt cutters, etc. The holder has longitudinal float, thus permitting the die to follow its own lead independent of the travel of the machine. With any self-leading die, it is impossible to adjust more than a few thousandths of an inch without materially disturbing the lead of the screw or bolt, or spoiling the smoothness of the wall of the thread. The range of adjustment secured by regulating the position of the cap *B* is more than can ever result from variation in the process of manufacture.

WEAVER GARAGE PRESS

In the average garage or repair shop there is a great deal of work which could be most satisfactorily handled under a press, but the high price of an ordinary equipment of this kind leads many shops to continue to handle such work by more laborious and far less efficient methods. Realizing the demand which exists for a light press for use in the field referred to, the Weaver Mfg. Co., Springfield, Ill., has designed and placed on the market a hand-operated press which has a capacity of 20 tons. This equipment is of strong and compact construction so that it takes up very little space and has a capacity ample for the requirements of the work for which it is intended. Straightening shafts and axles, pressing wheels on and off shafts, compressing leaf springs in assembling, pressing bearings on and off, broaching holes, cutting keyways in pulleys, and bending and shaping bars are some of the operations that can be accomplished.

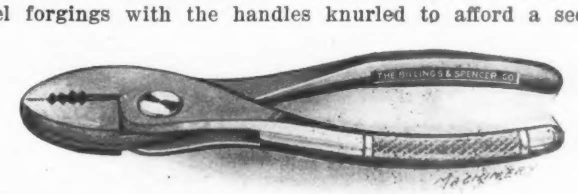


Hand-operated Press for Use in Garages and Repair Shops

It will be seen that the frame is made of a single piece of channel steel which is 5 by 2 inches in size. There are no joints or connections to weaken the frame. A handwheel 15 inches in diameter provides quick action for ordinary light jobs, and for securing the maximum pressure the auxiliary lever is employed. The ratio of the lever is 1500 to 1, and enables the maximum pressure of 20 pounds to be obtained without undue exertion on the part of the operator. The bolster which carries the plate is readily adjustable for height, it being necessary to remove the four bolts and replace them in holes in the desired position on the frame. The maximum adjustment of the press is 48 inches between the plate and the bottom of the screw. The screw is 2 inches in diameter and has a 3-pitch Acme thread; the thrust of the screw is taken by a bronze thrust bearing. The screw has a range of movement of 12 inches and the distance between the uprights is 32 inches, which permits the press to handle the largest automobile wheels.

BILLINGS & SPENCER BOX-JOINT PLIER

The model CC slip box-joint plier illustrated herewith is a recent product of the Billings & Spencer Co., Hartford, Conn. The application of the box joint to this plier insures perfect alignment of the jaws and side cutters. This increases the efficiency of the cutters, enabling them to cut easily any wire within their capacity. The tool is made of high-grade steel forgings with the handles knurled to afford a secure



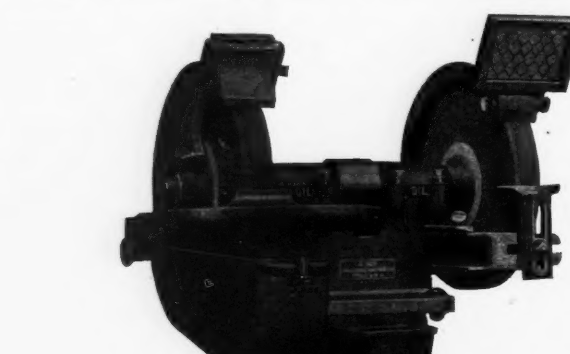
Billings & Spencer Model CC Slip Box-joint Plier

grip when the workman's hands are greasy. The features of the tool will be clear to any mechanic by referring to the illustration.

CHALLENGE COMBINATION GRINDER

Where a shop uses machine tools for a variety of work, the most efficient equipments are those which possess the widest range, this being in marked contrast to manufacturing machines which are used for turning out a strictly uniform product. There are few shops which have tools to be ground that do not have various other classes of grinding work, and where the tool grinders are single-purpose machines, it is necessary to have other grinding machines for handling miscellaneous work. Realizing the demand for a general-purpose grinder arising from this condition, the Challenge Machine Co., Inc., 5116 Springfield Ave., Philadelphia, Pa., is building what is styled a combination grinder. This machine has been built for some time but it has recently been re-designed and additional equipments provided to add to its field of usefulness. The name "combination grinder" arises from the fact that various units are provided which may be assembled on the machine to adapt it for handling various classes of work. These units are mounted without requiring any machining operations, and they may be easily removed and replaced by other units when the nature of the work handled on the machine is changed.

The head of the machine, or the "master unit" as it is called, may be used as a bench machine or it may be bolted to either of three types of base which adapt it for belt drive from an overhead shaft, belt drive from a pulley mounted on the base of the machine or individual motor drive. Among the units which may be provided for use on this machine are a ring wheel or disk unit; a wet tool grinding unit; a duplex surface grinding unit; a top surface grinding unit, in which the work is passed over a slot in the table through which the grinding wheel is exposed; and a wheel guard unit. It will

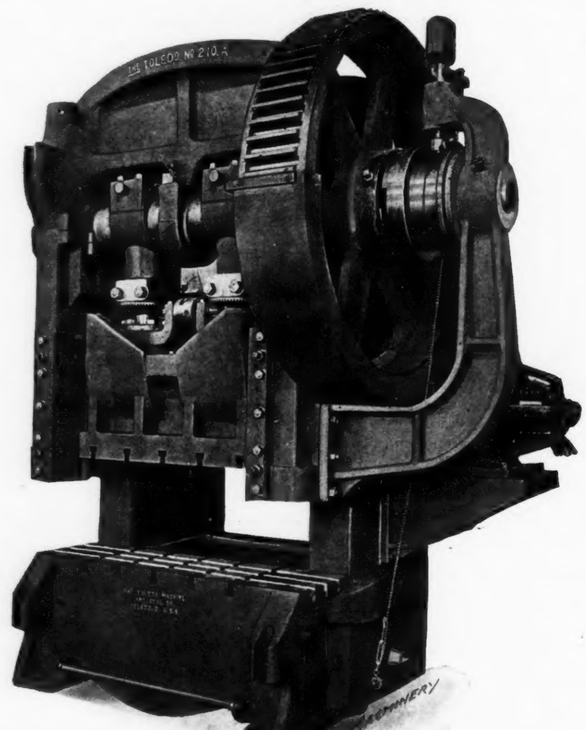


Challenge Combination Grinder equipped with Wet Tool Grinding Unit and Wheel-guard Unit

be seen that the machine shown in the illustration is equipped with the wet tool grinding unit and the wheel guard. The wheel guard is one of the recently developed parts. It is forged from channel steel, which provides adequate strength, and has both vertical and horizontal adjustment in order that the position may be regulated as the wheel is reduced in size through dressing. It will be noticed that an eye-guard is provided on this unit, the guard being made of wired glass so that it is not easily broken.

TOLEDO HIGH-SPEED FORGING PRESS

In the design of the high-speed forging press which forms the subject of this article, the construction of the frame is of particular importance. Referring to the illustration, it will be seen that this is of the gap pattern, the frame consisting of four pieces held together by four heavy steel bolts. Two of these bolts pass through the crown, uprights and bed of the press at the rear of the main shaft bearings, these bolts taking the entire stress in the press, while the uprights



Heavy Toledo High-speed Forging Press

take the reaction. The other two bolts are situated at the front of the bearings and pass through only the crown and uprights. This machine was originally designed for handling the heavier classes of railroad track specialty forging, such as switch operating levers and links, rail plates, fish plates, etc.; but it may be used for all classes of heavy forging, forming, stamping and embossing. The press is capable of exerting pressures up to 500 tons and will withstand occasional overloads of 40 per cent or more.

The bed and face of the slide are provided with T-slots to accommodate all kinds of dies mounted in every conceivable position. The clutch is of the jaw type; it is steel faced at the engagement points and equipped with a special gravity release that eliminates the clicking and wearing off of the engaging points. The press is designed to operate at high speed—the recommended speed being not less than thirty strokes per minute—so that four, five or more forging operations may be performed in succession on a piece of work without requiring it to be reheated. In order to provide for running the press at high speed, it is geared comparatively low, the ratio being fifteen to one, which brings the speed of the back shaft up to 450 revolutions per minute. It will be seen that motor drive is employed, and when the press is working under full load a 100 horsepower motor will be required to drive it to capacity. This does not mean that the press will consume that amount of energy continually; on the contrary, the average requirements will not exceed from 25 to 30 horsepower.

Forging presses are subjected to severe treatment and as a result are likely to have a variety of accidents happen to them. To prepare this new Toledo press to withstand the most severe operating conditions, it has been designed with

proportions that enable it to stand up under unusually heavy loads. Great care has also been exercised in the selection of material for those parts which are subjected to the most severe strains. For instance, the main shaft and the steel tie rods are made of steel of a special analysis which averages from 0.45 to 0.50 per cent of carbon; these parts are carefully treated after finishing to enable them to withstand the most severe stresses without being strained. The main gear is made of a special steel which possesses exceptionally good wearing properties. Particular care has been given to the design of the slide and its ways. The gibs are of unusual length and so arranged that the slide never comes out of the gibs. The part of the slide that moves within the gibs, and the gibs proper, are of exceptionally liberal proportions, and this fact combined with the length of the gibs permits of concentrating the heaviest load at any point of the slide and bed.

The principal dimensions of this machine are as follows: Stroke of slide, 6 inches; diameter of shaft, 10 inches; distance between uprights, 61 inches; available die space, 20 inches; size of main gear, 7 feet in diameter by 12½ inches face width; size of flywheel, 50 inches in diameter by 17 inches face width; and weight of flywheel, 4000 pounds. This new forging press is a recent product of the Toledo Machine & Tool Co., Toledo, Ohio.

BESLY GEAR TOOTH PATTERN GRINDER

Charles H. Besly & Co., 120 B. North Clinton St., Chicago, Ill., have recently developed a fixture for use on their No. 15-30 C patternmaker's disk grinder, which adapts this machine for forming single involute teeth for gear patterns. Fig. 1 shows one of these attachments in use, while Fig. 2 shows the design of the attachment in detail. The attachment is shown grinding teeth of 1 diametral pitch by 6 inches face width; and the fixture was especially designed for grinding 1-pitch teeth. The blanks are ground from the rough, *i. e.*, the grinder does everything with the exception of the rough sawing. In producing gear teeth on this attachment, the method of procedure is as follows: The rough sawed blocks are first ground on the top, bottom and ends, using a sliding bevel gage for squaring the ends, and a sizing bevel gage for grinding the top of the tooth pattern parallel with the base and to the correct height. After this preliminary work has been done, the blanks are ready to be inserted in the fixture for forming the sides of the teeth.

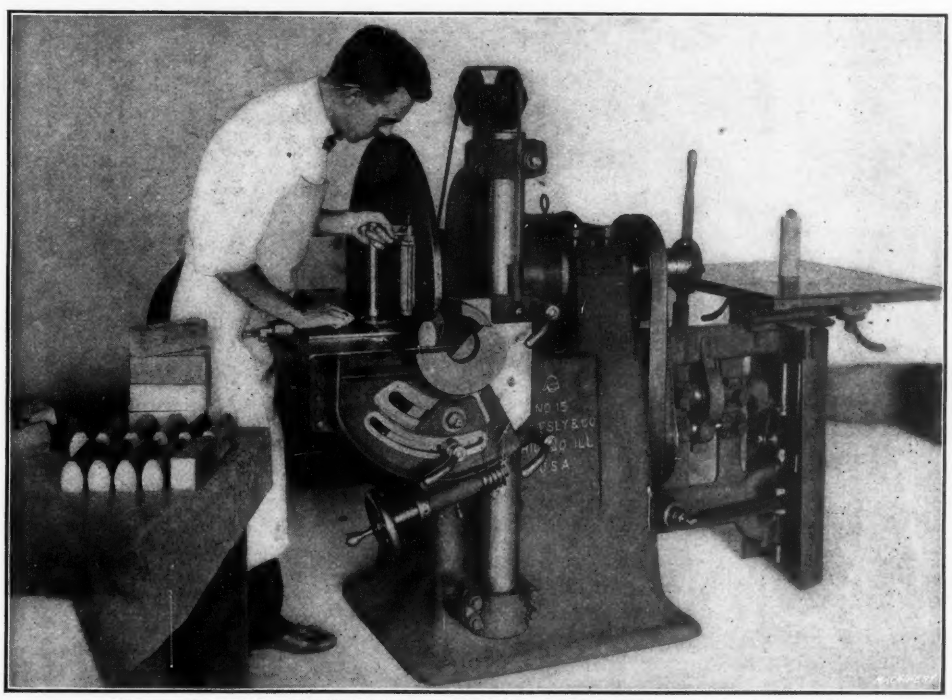


Fig. 1. Use of Gear Tooth Fixture on Besly No. 15-30 C Patternmakers' Disk Grinder

To operate the fixture, the base of the blank is placed against the back of the holder shown at *A* in Fig. 2, after which the plug *B* is pressed down so that the center point *C* imbeds itself in the wood. The plug *B* is then locked in place by tightening the thumb-screw *D*, which, in turn, chucks the work on the two points *E*. The next step is to set the stop-screw *F* to give the correct tooth thickness from flank to flank. This stop-screw engages the edge of the table of the disk grinder and controls the distance through which the work may be fed to the wheel. After setting the fixture for the tooth thickness, it is necessary to provide for obtaining the required flank angle and this is done by setting the pin *G* in the proper position in the segment of the fixture. The work is then forced against the grinding wheel until further movement is stopped by the screw *F* engaging the edge of the work-table as previously mentioned. After this has been accomplished, the spring pin *G* is released from the segment and the fixture swiveled back and forth about its pivotal center to grind the face of the tooth. After these two operations have been completed, the work has a flat flank and a circular face, but the face curve is not tangent to the flank.

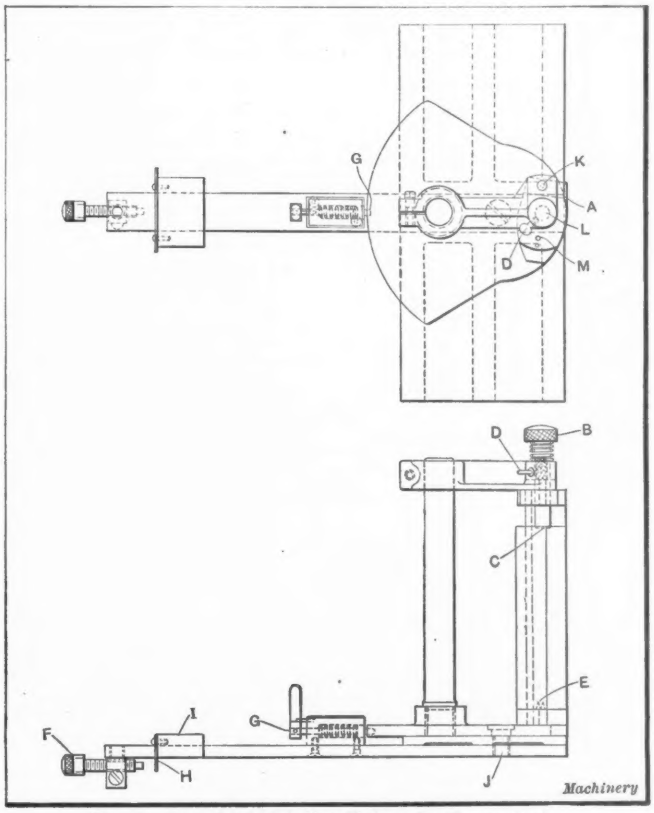


Fig. 2. Gear Tooth Grinding Fixture for Use on Besly Patternmakers' Disk Grinder

In order to secure a smooth surface and to approximate the required involute curve for the tooth, the next step is to withdraw the work from the wheel and move the leaf *H* carried by the block *I* into position against the end of the stop-screw *F*. After this has been done, the work is again brought into contact with the disk wheel and rotated about the pivotal center *J*. The effect of the leaf *H* is to increase the radius about which the fixture is pivoted, with the result that a so-called "face and flank" curve is generated, which is tangent to the flank of the pattern and connects smoothly with the face curve previously formed. The combination of the "face and flank" curve and the face curve results in the formation of a curve which is

a very close approximation to the required involute tooth form.

After this has been done, the work is withdrawn from the disk wheel and the pin *K* is withdrawn to enable the work-holder to be revolved about the center *L* in order to bring the opposite side of the pattern into position to be formed by the disk wheel. The pin *K* is inserted in the hole *M* which locks the work in position for forming the opposite side of the tooth. This process enables gear teeth which are exact duplicates of each other to be made, and teeth made on this fixture are much more accurate as regards size, curvature and parallelism than it has formerly been possible to make them. Using this fixture on a Besly patternmaker's disk grinder, an apprentice can turn out more work in a few minutes than a skilled patternmaker could in a day when working by hand.

CINCINNATI GRINDER HEADSTOCK

A recent improvement made on the plain and universal grinding machines built by the Cincinnati Grinder Co., Cincinnati, Ohio, consists of a headstock with means for providing either a live center or a dead center according to the requirements of the work. The illustrations show the headstock for a universal grinder, but after reading the following description, it will be evident that the same arrangement is equally applicable for use on plain grinding machines. This

Fig. 1. Front View of Cincinnati Headstock

new headstock is secured to the reciprocating table in the usual way. The spindle runs in any suitable form of bearings, and in the forward bearing a shoe is provided which enables the spindle to be clamped by tightening a hand-screw that binds the shoe against the spindle.

It will be seen that the spindle projects out from the front bearing and that a sleeve *A* is keyed to the spindle so that it rotates in unison with it. The driving pulley is journaled on the sleeve *A*, this pulley being provided with a lubricated anti-friction bushing. The pulley is held against longitudinal movement by means of the flange on the sleeve *A* and a similar flange on sleeve *B* which is threaded onto the end of the spindle. The faceplate *C* is secured to the

Fig. 2. Opposite Side of Cincinnati Headstock

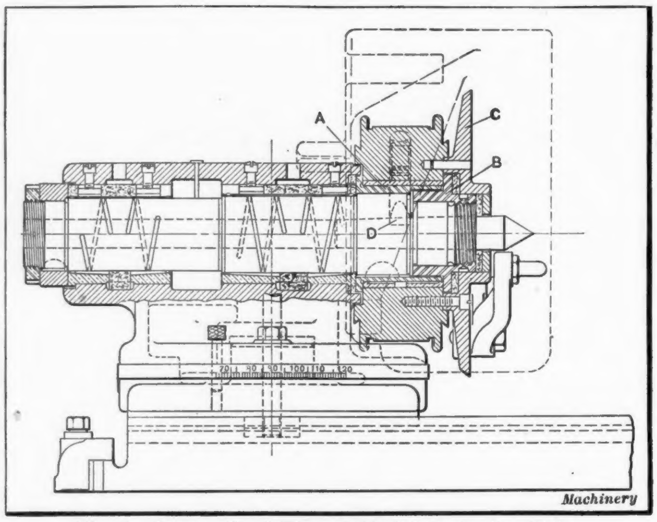


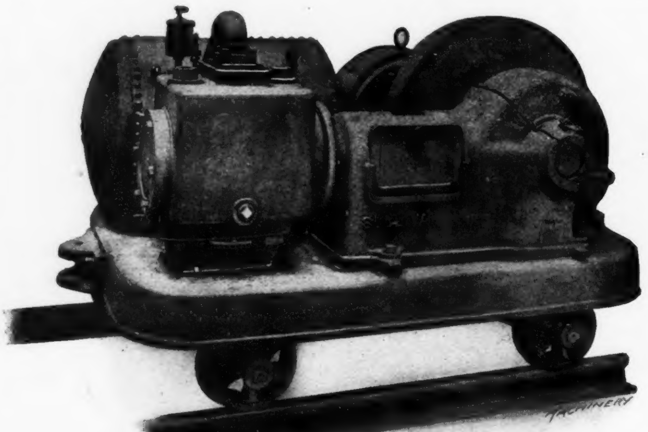
Fig. 3. Cross-sectional View of Headstock showing Tight or Loose Pulley Feature

pulley and provided with a work-engaging stud; and the end of the spindle hole is tapered to receive the usual form of tapered shank center or chuck, according to the requirements of the work.

When it is desired to operate the headstock with a live center the shoe *D*, which is carried in a socket in the pulley, is tightened by a screw so that the pulley is clamped to the sleeve *A* and consequently to the spindle. Under these conditions, the spindle rotates in the headstock, providing a live center. In order to obtain a dead center, the shoe *D* is loosened and the shoe in the front spindle bearing is tightened in order to bind the spindle and prevent it from rotating in the headstock, thus providing a dead center.

SULLIVAN PORTABLE AIR COMPRESSOR

The small motor-driven air compressor illustrated herewith is an extremely useful equipment in industrial plants which require compressed air for operating pneumatic tools and for other purposes. The complete unit is mounted on a truck of any desired wheel gage and is driven by a 15-horse-power motor supplied by the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Referring to the illustration, it will



Sullivan Motor-driven Portable Air Compressor

be seen that the equipment comprises the air compressor, a storage tank and a motor starting rheostat in addition to the driving motor. The motor is of the damp-proof type and will operate successfully in very damp locations. A motor may be provided for use on either alternating or direct current.

The receiver is made of plate steel and is tested to withstand an air pressure of 100 pounds per square inch. A pop safety valve, a pressure gage and a blow-off or drain cock are provided on the receiver. The construction of the air compressor is very substantial. All bearings are provided with means of adjustment and may be easily removed, so that re-

placement is an easy matter, when necessary. The cylinder is lubricated by a sight-feed air cylinder lubricator, and the crankshaft and crosshead by the splash system. An unloading device on the air inlet valves saves energy when the demand for air is less than the capacity of the machine. This portable air compressor is a recent product of the Sullivan Machinery Co., Chicago, Ill.

LANGELIER HIGH-SPEED BENCH DRILL

The accompanying illustration shows a high-speed bench drill designed and built by the Langelier Mfg. Co., Providence, R. I., for use in drilling fine holes through steel piano wire gages. The machine may also be used for milling and burring small work. The standard machine of this type has a spindle turned to a taper to fit the No. 0 Morse taper socket of a Beach chuck for drills from No. 0 up to 1/8 inch. If so desired, any special spindle nose may be provided to meet the requirements of individual cases. This bench drill is designed to run at speeds between 4000 and 5000 revolutions per minute.

Langelier High-speed Bench Drill for driving Drills up to 1/8 Inch

The main spindle is made of hardened and ground tool steel and runs in perforated phosphor-bronze bushings inside the feed sleeve. The perforations in these bushings act as reservoirs for collecting and distributing lubricant, which is supplied through a small tube oiler at the left-hand side of the feed sleeve bearing. The pinion feed shaft is pivoted on two hardened steel centers and the sleeve is fed by pressure of the thumb applied on the thumb lever shown at the right-hand side of the machine, which makes the drill exceedingly sensitive. The handle which projects at the right-hand side of the frame is a rest for the operator's hand and serves to steady it while feeding the sleeve by means of the thumb lever. A closely wound but very resilient steel spring located at the left-hand side of the machine returns the spindle the moment the pressure is released from the thumb lever.

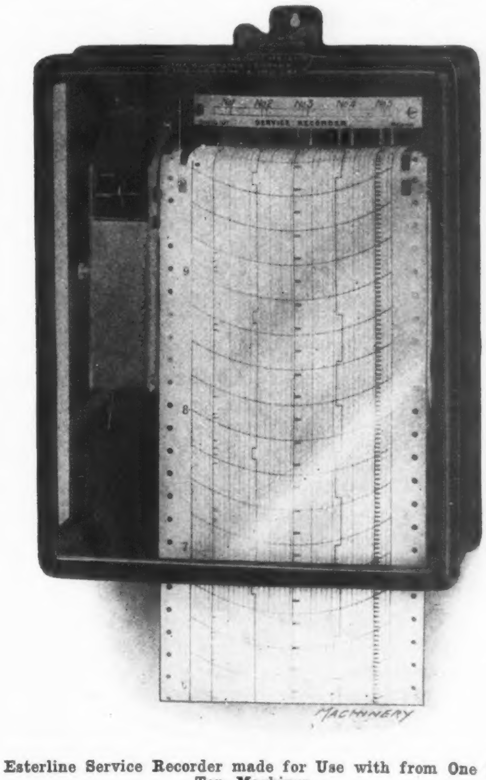
In order to maintain the maximum sensitiveness of the feed and spindle return, the driving pulley, which is 1½ inch diameter by 9/16 inch face width and flanged for a 3/8-inch cotton belt, is mounted over a projecting phosphor-bronze bushing which is fixed in the upper bearing of the main spindle. The pull of the belt is carried by this bearing, which entirely relieves the main spindle from strains due to the belt tension. Two steel keys projecting from a steel driving collar, set flush and locked in the upper side of the driving pulley, engage two keyways in the main spindle, the drive being effected in this way.

The driving belt idler pulley bracket may be adjusted in or out to maintain the proper belt tension; this bracket is reversible to provide for driving the machine from above or below the bench. The idler pulleys are 2 inches in diameter by 9/16 inch face width, and are mounted on loose phosphor-bronze bushings which are perforated to distribute the oil over the pulley bearings. The work-table is accurately finished to bring it exactly square with the drill spindle. It may be adjusted vertically through a distance of 3½ inches or swung to either side to provide for handling special work. The distance from the lower end of the chuck to the table surface when the table is at the bottom of its adjustment is 6½ inches. It will be seen that the base of the machine has a projecting rim to provide for catching chips, etc. The bench space occupied is 11½ inches square, and the weight of the machine about 63 pounds.

ESTERLINE SERVICE RECORDER

Competition in manufacturing has encouraged the development of a number of instruments and devices intended to increase efficiency in machine tool operation, among which the service recorder may be mentioned. A new instrument of this type has recently been placed on the market by the Esterline Co., Indianapolis, Ind. This meter operates on the same general principles as common graphic or curve drawing instruments; it is equipped with any number of pens desired from one to ten inclusive, and each of these pens is controlled electrically. The entire instrument is mounted in an enameled metal case, with rubber covered binding posts located at the bottom for making connections, and the case has suitable lugs at the top and sides for fastening to a wall or partition. The front cover enclosing the chart and clock, is provided with glass panels on the sides, top and front to permit inspection of the record without opening the instrument. The pens rest on a long strip of paper or record chart which is driven through the meter at a constant rate of speed by a jewel balance wheel type of eight-day clock. This clock may be equipped with gears giving five paper speeds of ¾, 1½, 3, 6 or 12 inches per hour, and an attachment can also be provided giving additional chart speeds of 45, 90, 180, 360 and 720 inches per hour.

The clock is provided with stops so that its operation may be interrupted at any time, and a regulator is furnished for adjusting the speed while in service. Clocks are furnished with a re-rolling device for winding up the finished record in the bottom of the case, or this device may be dispensed with and the finished chart fed through a slot in the bottom of the cover, the record being torn off daily. Record charts are supplied in rolls 90 feet in length and 6 inches in width, and this record may be cut up in short lengths for convenience in filing. Perforations are provided along each margin of the chart which are engaged by pins on the clock driving roll, insuring perfect alignment of the paper and accurate timing of the clock. Each pen is so controlled that when a record is made, a vertical line about 1/8 inch in length is



Esterline Service Recorder made for Use with from One to Ten Machines

drawn across the chart, the pen returning to the zero position after each record is made. The controlling devices for the various pens are connected to different machines in such a way that one record is produced for each operation or for a certain number of operations. On account of the paper being drawn through the meter by the clock, the resulting record is a series of short lines, the spacing of which represents the rate at which operations are being completed. If the machine is being operated up to capacity, the series of lines will be close together, but if the machine stands idle for several minutes, a straight line will be drawn on the chart showing that no work was accomplished during that time.

The electrical control for the pens is very efficient and requires such a small amount of current that the power consumption is negligible. The instruments have high internal resistance and may be operated at any distance from the machines. One instrument may be located in the superintendent's or manager's office and operated by small wires connected to the machines located at various parts of the plant several thousand feet away. Any source of direct current may be used for operating the instrument. On machines operating at a high rate of speed and completing a number of pieces or operations in a short period of time, it is advisable to gear the controlling device on the machine so that one line on the chart will represent 10, 100 or any other convenient number of operations. On account of the large number of chart speeds that may be obtained on this instrument, it is easily possible to get a suitable record on any class of work. If operations are completed at a slow rate, then the chart may be operated at a slow speed so as to shorten the record; but if operations are completed at a rapid rate, then a faster chart speed will give a clearer record. These instruments are also furnished with a counting attachment arranged in such a way that they total up the operations so that the total production for a day or period can be quickly determined direct from the recorders. Service recorders are used for a variety of purposes in addition to machine tool recording. Each pen can be arranged to give a record of when motors or other machines are being operated and when idle.

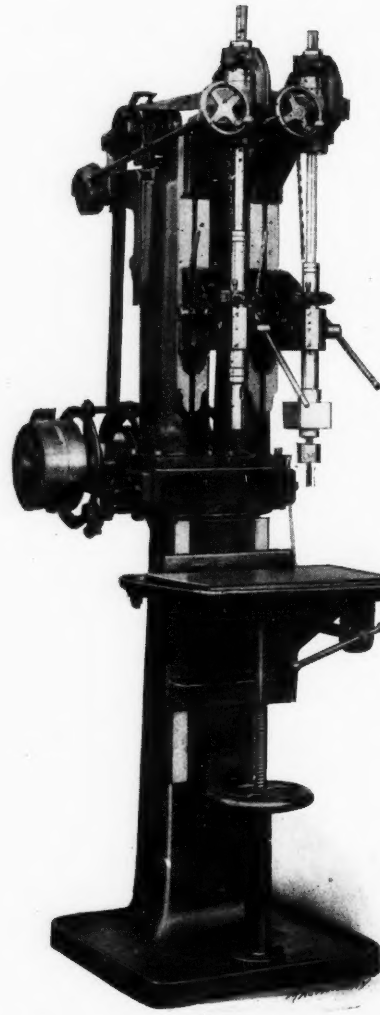


Fig. 1. Henry & Wright Drilling Machine equipped with New Tapping Attachment

HENRY & WRIGHT TAPPING ATTACHMENT

The Henry & Wright Mfg. Co., 760 Windsor St., Hartford, Conn., is now making a tapping attachment which is illustrated herewith. The noteworthy feature of this device is that the forward drive is direct from the spindle of the drilling machine to the tapping chuck, while the reverse is through gearing which backs out the tap at a speed increase of about 20 per cent. The operation of the mechanism will be best understood by referring to Fig. 3. The gear *A* is secured to the sleeve or shank by which the attachment is connected to the spindle of the drilling machine. This gear rotates right-hand, and when it is desired to drive the tap forward the gear *A* is secured to the driving stem *B* on the tapping chuck. When it is desired to reverse the tap to back it out of the hole, this result is obtained by securing the gear *C* to the stem *B*. When this is done the drive from the gear *A* to the gear *C* is through the two idler gears which reverse the direction of rotation.

The connection of the gear *A* or the gear *C* to the driving stem *B* is effected by means of the three balls *D* which are carried in the driving stem. When the tap is fed into the hole, these balls enter the pocket in the driving gear *A*, which is eccentric to the driving stem *B* of the chuck. The resistance offered by the tap causes the balls *D* to bind in the pocket of the gear *A*, thus effecting a clutching action which possesses ample power to drive the tap direct through the stem *B*. The gear *A* causes the gear *C* to rotate, but during the forward motion of the tap the gear *C* is loose on the stem *B* and plays no part in the drive.

When the hole has been tapped to the required depth, and the feed lever on the drilling machine is drawn up, the balls *D* are pulled out of the pocket in the gear *A* and enter a similar pocket in the gear *C*, except that the eccentricity of this pocket relative to the driving stem *B* is in the opposite direction. In moving from the gear *A* to the gear *C*, the balls *D* pass the neutral position which is shown in Fig. 3, so that the attachment is momentarily at rest before the reversal takes place. This tends to relieve the mechanism of the shock of a sudden reversal. When the balls enter the pocket in the gear *C*, the gear *A* drives through the two idler gears, thus reversing the direction of rotation of the tap and backing it out of the hole. As previously mentioned, the ratio of the gearing is such that the tap is backed out at a speed increase of 20 per cent.

It will be seen that two methods of connecting the attachment to the drilling machine are shown in Fig. 3, one of these consisting of a sleeve which fits over the spindle and is driven by a key passing through the drift slot, while the other consists of a No. 2 Morse taper shank with the usual form of driving tang. Figs. 1 and 2 illustrate an even better method of attachment, which consists of making the attachment a part of the drilling machine spindle. At present these tapping attach-

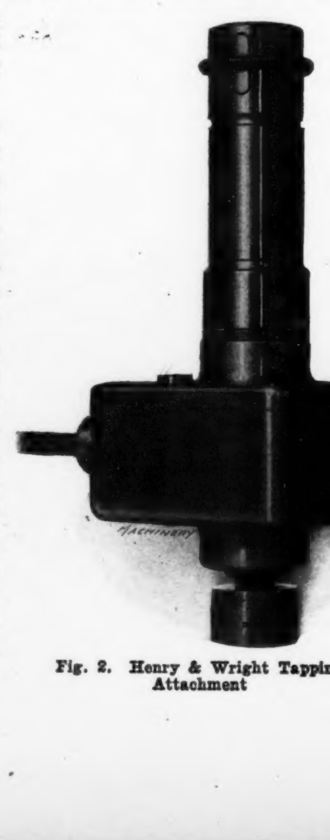


Fig. 2. Henry & Wright Tapping Attachment

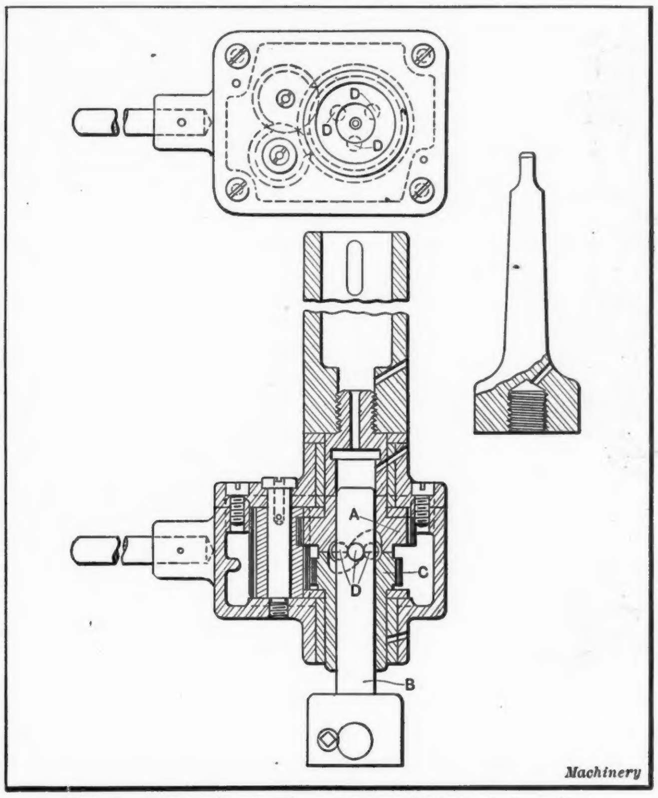
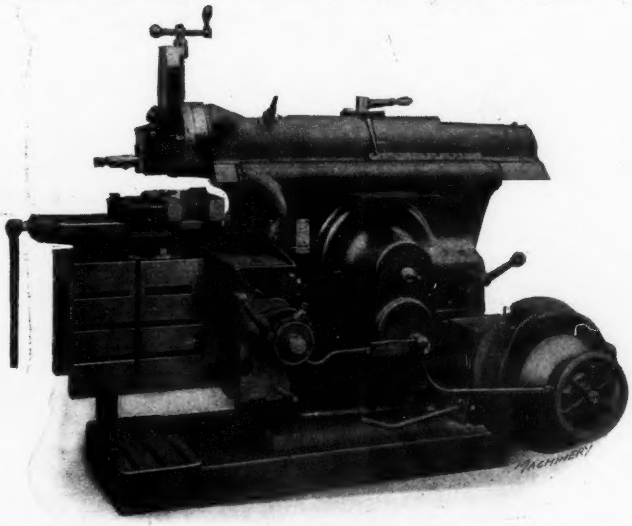


Fig. 3. Cross-sectional View showing Method of Operation

ments are being made in two sizes known as Nos. 4 and 5. The No. 4 attachment will drive taps up to 3/8 inch, while the capacity of the No. 5 attachment is for taps up to 1/2 inch. In a recent test conducted in the manufacturer's factory, a 1/4-inch tap with twenty threads to the inch was operated in tapping holes 3/8 inch deep in malleable iron at the rate of one thousand holes per hour. The tap broke after completing 19,367 holes, which shows that the operation of the attachment is so accurate that no undue strain is put on the tap.

GOULD & EBERHARDT SHAPER PULLEY GUARD

The application of a constant-speed single-pulley drive instead of the four-speed cone pulley used on the shapers built by Gould & Eberhardt, Newark, N. J., makes possible the application of a gear guard to meet the most stringent requirements for safety measures for the protection of factory employes. It will be seen from the illustration that the guard completely encloses the pulley and clutch, so that it is impossible for the operator of the machine to be injured. The guard may be set around to any required position, according to the belt angle, and if necessary may be very easily removed. Progressive machinery builders are coming to recognize the desirability of equipping their machines with all necessary guards. Where this practice is followed, the guard is designed with the same care as other parts of the machine, and as a result it harmonizes with the machine instead of being an eye-sore, as it so often is when applied after the machine has been placed in operation in the user's shop.



Gould & Eberhardt Shaper equipped with a Guard over the Constant-speed Pulley

The single pulley is equipped with an improved form of clutch and brake, controlled by a lever, so located that the operator can stop the machine at any point of the stroke without requiring the driving belt to be stopped. The gear box is of the selective automobile transmission type. It is of simple design and the gears are easily shifted while the machine is running. In shifting from the lowest to the highest speed, however, it is desirable to stop the machine for a moment before re-engaging at the higher speed. The gears in the box have cut teeth and run in oil; they are made of hardened vanadium steel to give them a long life under the most severe operating conditions. The changes of speed are obtained by shifting the bottom lever shown in the illustration. It will be seen that there are four positions in which this lever can be located to give any of the four speed changes, the arrangement being such that two speeds cannot be engaged at the same time. This number of speeds is doubled by the back-gears, giving a total of eight available speeds. The back-gears are engaged by means of a small lever shown above the gear box at the extreme right of the illustration. Driving direct on a 28-inch shaper, the speeds obtained from the gear box are 39.9, 58.1, 821 and 115.3 strokes per minute. With the back-gears in, the corresponding speeds are 9.35, 13.22, 19.24 and 27 strokes per minute. The handwheel on the pulley shaft provides means for adjusting the drive to engage the back-gears when the machine is not in motion.

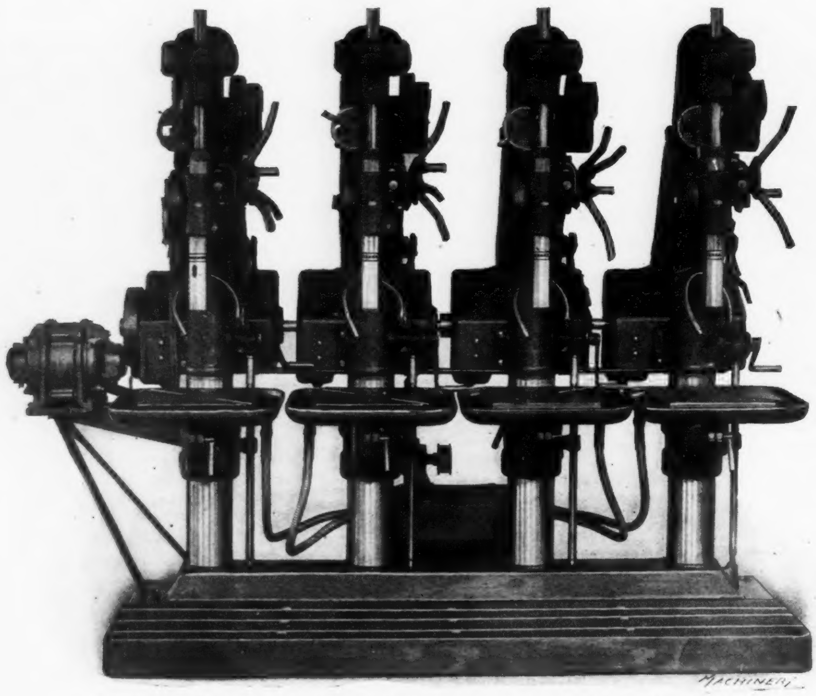
BERNSTEIN FACTORY TRUCK

For handling bar stock, the Bernstein Mfg. Co., Third St. and Allegheny Ave., Philadelphia, Pa., is manufacturing the steel factory truck which is shown in the accompanying illustration. The noteworthy feature of this equipment is that it is made of steel tubing and is practically indestructible. The uprights are made of 1 3/8-inch stock, while the horizontal braces are of 1 1/8-inch stock, these members being connected by chilled joints which are not likely to break. The truck is mounted on swivel wheels 6 inches in diameter, the wheel brackets being attached to the uprights of the truck by steel pins. The truck is 18 inches wide by 24 inches long; the height of the lower tier from the floor is 10 inches, and the clearance between the upper and lower tiers, 11 inches. When so desired, heavy removable steel shelves may be mounted on the tiers, and trucks of this type can be made with any number of tiers and in any required size.

Bernstein Truck for handling Bar Stock

BARNES GANG DRILLING AND TAPPING MACHINE

In the June, 1914, number of MACHINERY, the 20-inch self-oiling, all-geared drilling and tapping machine built by the Barnes Drill Co., 814 Chestnut St., Rockford, Ill., was illustrated and described. Since that time, the Barnes Drill Co. has developed a gang drilling and tapping machine which comprises four machines of the type described in the previous article referred to, which are mounted on a common base. Referring to the illustration, it will be seen that the



Four-spindle Drilling and Tapping Machine made by the Barnes Drill Co.

four machines are driven by a common motor and that a common reservoir and pump serves to deliver oil to all four machines.

Aside from the changes in construction incident to mounting four machines on a common base, the design follows closely along the lines of the single drilling and tapping machine. For the benefit of those who did not read the previous description, a brief summary of the important features will be presented. The exceptional strength and power of the self-oiling, all-geared machine makes it possible to operate at the maximum speeds and feeds of high-speed steel twist drills. Every bearing, with the exception of the spindle sleeve and cross spindle bearings, is self-oiled. Each spindle is provided with eight changes of geared speed and eight changes of geared feed, all of these changes being under instant control of the operator without requiring him to leave his position at the front of the machine. All speeds and feeds are independent of each other, and all gears are fully enclosed to meet the requirements of modern safety laws.

The spindles may be provided with back-gears, geared feeds and automatic stop; or with simple geared feeds and automatic stop. Reversing friction clutch gears and automatic reverse may also be applied, when required for the class of work to be handled on the machine. The oil for the self-oiling system is delivered to each machine from a common reservoir and distributed to all of the gears and bearings including the crown gears and the feed-box. Those who are interested in a more detailed description of the design and construction of the machine are referred to the description of the single machine published in June, 1914.

CINCINNATI BORING MILLS

One size of an improved line of boring mills which has been added to the products of the Cincinnati Planer Co., Cincinnati, Ohio, and which embodies all of the latest features of boring mill design, is shown in the accompanying illustrations. This line of machines includes six- and seven-foot sizes. The table is driven by a bevel gear and pinion, with the pinion supported by an extra bearing in the bed to eliminate the objectionable features of the overhang construction. The table rests on a self-centering angular track and is guided by a long spindle which revolves in bushed bearings in the bed. The angular table track is self-oiled by a spiral groove in the table which carries the oil from the reservoir to the top of the track, after which it returns to the reservoir. The vertical spindle bearings are oiled from the outside, the oil being delivered through a pipe of ample dimensions and distributed by spiral grooves on the spindle.

Either motor or belt drive may be employed to deliver power to the top shaft, from which a belt transmits the motion to the driving pulley at the base of the machine, the arrangement being clearly shown in Fig. 2. Power is also taken from the top shaft to operate the rail-elevating mechanism and the rapid power traverse mechanism. Twelve table speeds are provided, four of which are obtained from the speed box which is cast integral with the bed. The long lever with a pointer, which is clearly shown on the side of the housing in Fig. 1, controls two speeds and this lever also operates the brake which stops the table. This brake is a new feature of Cincinnati boring mills which operates automatically and has a constant braking value irrespective of the table speed. As soon as the handle is moved into the neutral position, the brake acts automatically and stops the table without any further effort on the part of the operator. The vertical handle shown at the side of the housing controls two speeds through a jaw clutch. The two handles referred to are carried on shafts which extend through to the opposite side of the machine, where a duplicate set of handles is provided to make it possible to obtain the speed changes from either side.

The feed is taken from the main driving shaft on the inside of the bed, the motion being transmitted to the feed-

Fig. 1. Front View of Improved Cincinnati Boring Mill made in Six and Seven Foot Sizes

boxes at the sides of the housings. A tumbler gear arrangement gives five changes of feed, which are doubled by the handle shown at the side of the feed-box, thus providing ten changes of feed, each side being independent of the other. The feed reverse lever is conveniently placed for the operator; it is shown at the extreme front of the feed-box. The handles shown on the vertical rods control the rapid power traverse; the operation of these handles is extremely simple and "fool-proof." By turning the handles to either the right or left, the clutch from the feed-box is automatically disengaged, after which the rapid power traverse clutch becomes operative. The direction in which the handles are moved indicates the direction in which the heads will move. Sensitive adjustment handles are provided on the screw and rod for making the final adjustments of the tools; these handles are moved along the screws so that they are within instant reach of the operator at all times.

The rail is of extremely heavy construction and clamped on both the inside and outside of the housing faces. The saddles have a long narrow guide bearing at the bottom of the rail which eliminates binding action while the heads are under cut, in this way relieving the feed mechanism from excessive strains. The housings are carried to the floor and locked to the sides of the bed by heavy tongues, bolts and dowel-pins; they are fastened at the top by a heavy arch. "Safety First" has not been overlooked in the design of these machines, as all gears and other revolving parts are completely enclosed.

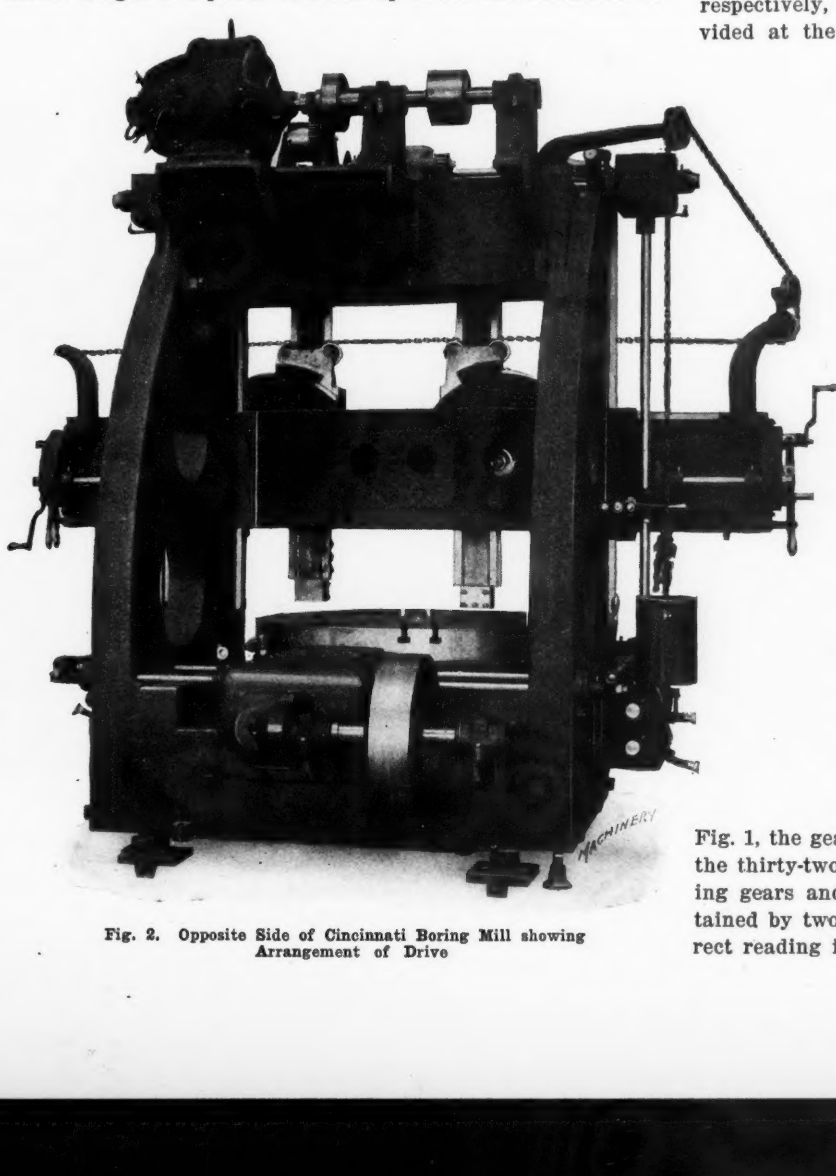


Fig. 2. Opposite Side of Cincinnati Boring Mill showing Arrangement of Drive

ROCKFORD 13-INCH "ECONOMY" LATHES

To meet the demand for a small, heavy-duty lathe of sufficient weight and power to stand up under the conditions of rapid production existing in the up-to-date manufacturing plant, the Rockford Lathe & Drill Co., Rockford, Ill., has added to its line a 13-inch, double back-geared machine which is built with quick-change gears as shown in Fig. 1, or with a semi-quick-change gear mechanism as illustrated in Fig. 2. The machine is particularly well suited for handling the work of garages and general repair shops, and possesses the necessary accuracy to enable it to fulfill the requirements of toolroom work. The same description applies to both machines, with the exception of the paragraphs referring to the change gears.

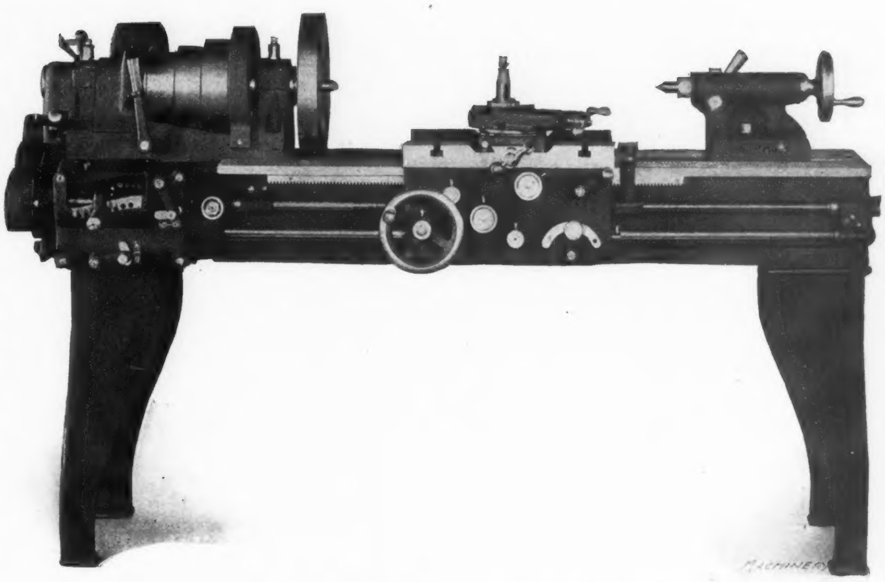


Fig. 1. Rockford 13-inch "Economy" Lathe equipped with Quick-change Gear Unit

The bed is of deep cross-section with wide cross braces at short intervals which, together with its liberal proportions, effectually eliminate all vibration. The headstock is of massive construction and firmly bolted to the bed; it has a three-step cone pulley with steps of 6, $7\frac{1}{4}$ and $8\frac{1}{2}$ inches respectively, and carries a $2\frac{1}{2}$-inch belt. A handle is provided at the front of the head which affords a convenient means for shifting the double back-gears. The spindle bearings are bushed with high-grade phosphor-bronze, and the spindle is made of high-carbon steel accurately ground and with a 1 5/16-inch hole through it. The thrust on the spindle is taken by a special thrust bearing, consisting of alternate collars of hardened steel and bronze. The tailstock is of the offset type and may be set over to provide for turning tapers. The tailstock spindle can be locked by an improved form of clamp, which does not require the barrel to be split and so adds greatly to its strength.

The carriage has an unusually wide bridge which permits taking heavy cuts without chatter. The thread indicator can be disengaged when not in use; this indicator, like other types of instruments used for the purpose, enables the operator to catch any pitch of thread without reversing the lathe. The apron is of heavy design and provided with double bearings for all shafts, which is a very essential feature of a heavy duty lathe. The gears are of wide face and coarse pitch. All feeds are reversed in the apron and interlock with the bronze lead-screw nut, making it impossible to engage the lead-screw and feed-shaft at the same time.

On the quick-change gear lathe illustrated in Fig. 1, the gear box is a simple and powerful unit which gives the thirty-two changes of threads and feeds by means of sliding gears and hardened steel clutches. The changes are obtained by two handles in connection with the tumbler. A direct reading index plate is mounted on the front of the gear

box. From 4 to 56 threads per inch may be cut without requiring the removal of any gears; and special pitches may be cut by substituting extra gears on the quadrant, an almost unlimited range being obtainable in this way. All gears in the quick-change unit have wide face and coarse pitch and are cut from solid steel blanks. The lead-screw and feed-shaft operate independently of each other and either the lead-screw or the feed-shaft is engaged by means of the knob at the front of the box.

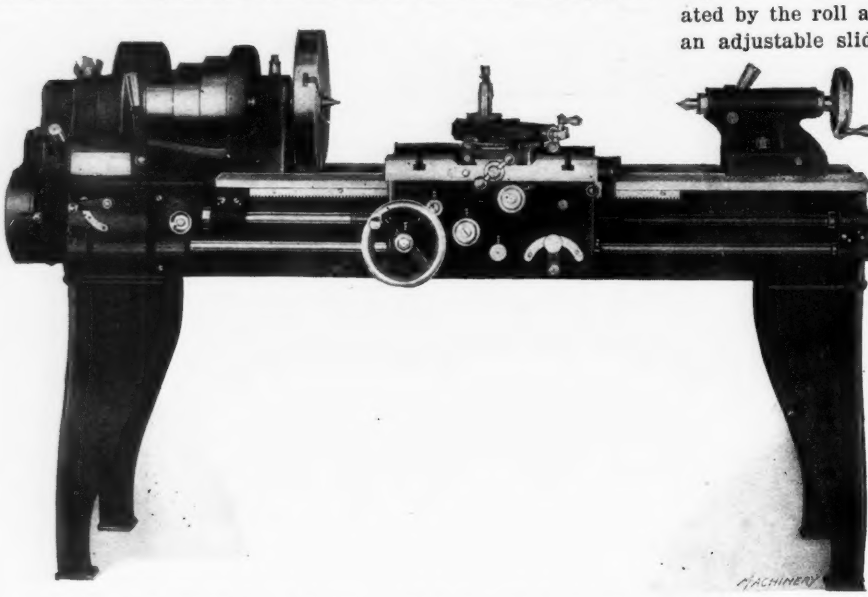


Fig. 2. Rockford 13-inch "Economy" Lathe with Semi-quick-change Gears

The machine shown in Fig. 2 is equipped with what is known as a semi-quick-change unit which provides three quick changes of feeds and threads for each change of gears, these changes being obtained through sliding gears and hardened steel clutches. A practically unlimited range of feeds for all classes of work may be obtained in this way. This gear box also simplifies thread cutting operations, each three changes of pitch being obtained by one change of gears. The necessity of compounding gears which has been one of the great drawbacks of change gear lathes is avoided. As in the quick-change gear lathe, the lead-screw and feed-shaft operate independently, either the lead-screw or the feed-shaft being engaged by the knob at the front of the box.

The principal dimensions of these 13-inch Rockford lathes are as follows: Swing over ways, 14⅛ inches; swing over carriage, 8 inches; distance between centers with a six-foot bed, 37 inches; length of bed, 6, 8 or 10 feet; ratio of back-gears, 3.42 : 1 and 9.07 : 1; available spindle speeds, 20 to 435 revolutions per minute; size of tool used, ½ by 1 inch; net weight of quick-change gear lathe with a six-foot bed, 1450 pounds; and net weight of semi-quick-change gear lathe with six-foot bed, 1425 pounds.

WATERBURY-FARREL DIAL PILLAR PRESSES

The accompanying illustrations show machines belonging to a new line of pillar presses manufactured by the Waterbury Farrel Foundry & Machine Co., Waterbury, Conn. These machines may be equipped with either a ratchet dial attachment or a friction dial attachment, according to the requirements of the work; and the attachments are interchangeable. In order to avoid the difficulty which has been experienced in applying the usual forms of dial feed attachments to pillar presses, two special mechanisms have been designed to meet the requirements of this type of machine. The construction and method of operation of these two dial feeds will be readily understood from the following description and illustrations.

Fig. 1 shows one of the Waterbury-Farrel pillar presses equipped with the ratchet dial attachment, and Figs. 2 and 3 show front and rear views of the mechanism which controls the operation of the dial. Referring to these illustrations, it will be seen that the pawl is mounted on an arm A which causes it to move in a circle concentric with the dial. It will be seen that link B is connected to the end of the pawl which is shaped like a bellcrank, and that there is a stop on the arm A which limits the motion of the pawl. The link B is operated by the arm C, which is pivoted at a point behind the right-hand upright of the press; this arm is, in turn, operated by the roll arm D, the two members being connected by an adjustable sliding block which may be regulated for the use of any number of notches in the dial from 12 to 24. The pawl, together with the complete dial driving mechanism, is returned by a spring which is located in such a way that it acts on both the levers C and D, eliminating lost motion from the mechanism and making the safety device (which will be described in a subsequent paragraph) more positive in action than it would be if the levers were allowed to get loose at the joint.

The timing of the dial operating cam, which, as shown, is mounted on a side shaft and driven from the left-hand end of the crankshaft by bevel gears, is such that the dial starts to move forward when the ram is half way up and the indexing of the dial is completed at or before the time when the ram reaches the highest point of its stroke. The cam holds the pawl and dial in this position until the ram has practically reached the lowest point of its stroke, and by this time the tools have entered the dial so that before the pawl releases it, all possibility of its shifting out of place has been eliminated. When the pawl starts to move back, the first part of the motion consists of lifting the pawl out of the dial notch, this motion being limited by the stop in the lever A. The lever A is then carried back until the pawl has been brought into position to enter the next notch in the dial. It will be evident from this description that the wear resulting from drawing the pawl over the dial is eliminated. Dur-

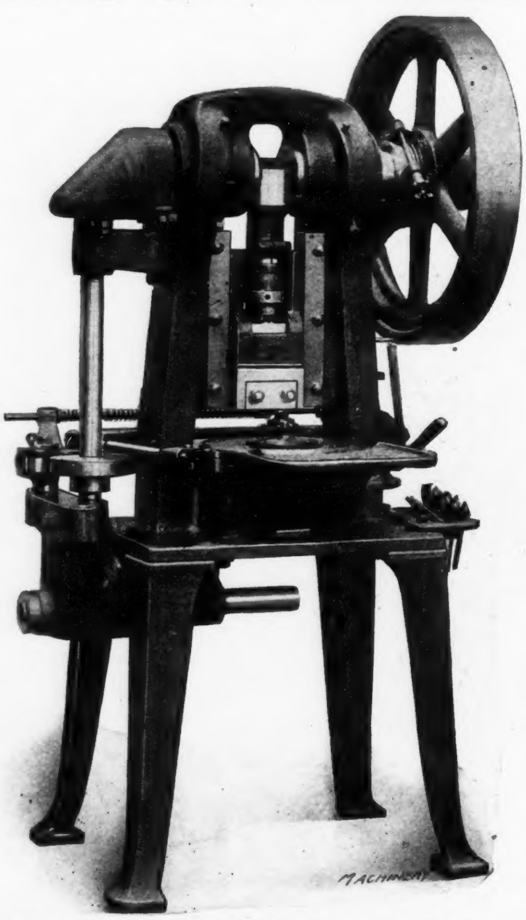


Fig. 1. Waterbury-Farrel Pillar Press equipped with Ratchet Dial

ing this time, the ram has moved up and if, through the breaking of any part or from some other unusual condition, the dial is not indexed to the right place, the locking lever E which is mounted on the lever C, will not enter the slot in the dial, and as a result, the opposite end of the lever E will engage the stop on lever F, thus holding this lever up and making it impossible to engage the clutch for the next stroke of the press. The arrangement of this mechanism is clearly shown in Fig. 3.

In running a dial press, it sometimes happens that the knockout will fail to bring the work out of the die or that the bottom of a shell will be torn out in drawing it through the die, thus leaving a shell between the die and the dial. To avoid a serious accident in the event of an occurrence of this kind, the link B is so designed that it will be bent or broken before any other part of the press gives way, and as this link is simply a piece of cold-rolled stock, an accident of this kind is not serious. The clutch furnished on these machines is of the standard key type and the knockout is operated from cams carried on an under motion shaft, the cams acting directly on the end of a straight knockout rod. The knockout shaft is made of ample size and overhang, so that the cams can be readily changed. Its construction allows special cams to be easily substituted if necessary, and while the knockout motion can be easily changed to suit the work, its operation is very positive and the same type of mechanism has been used for many years on machines of the eyelet type. Referring to the general view of the machine shown in Fig. 1, it will be seen that all gears are thoroughly guarded and that a table is provided for holding the work; also that there is a shelf on the side of the machine for holding the wrenches that are required for making adjustments. The machine is controlled by a hand lever, or a foot treadle can be used without requiring any change in the controlling mechanism.

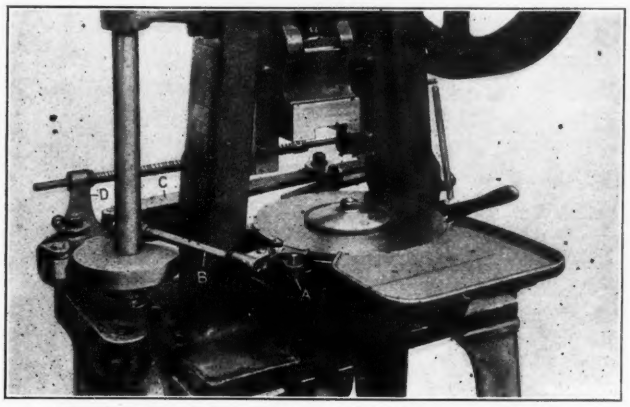


Fig. 2. Front View of Ratchet Dial Operating Mechanism

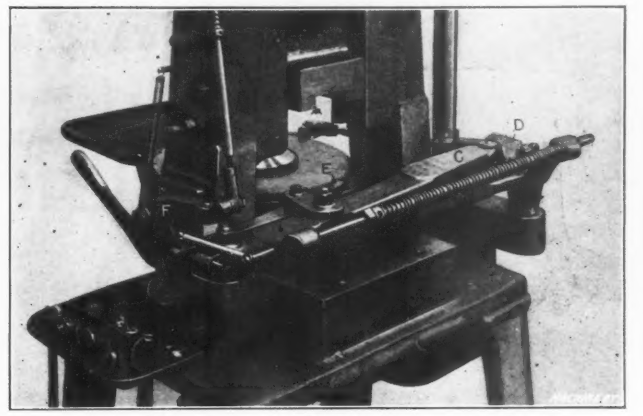


Fig. 3. Rear View of Ratchet Dial Operating Mechanism

Fig. 4 shows one of the Waterbury-Farrel pillar presses equipped with the friction dial attachment. There is nothing particularly unusual in the design of the friction dial, except that it is so arranged that the work can be either carried through the dies or brought up by the knockout so that it can be knocked from the top of the dies, a knockoff attachment being furnished for this purpose. Users of power presses know that a friction dial machine, while it is only useful for one operation and is only applicable for handling round work, can be operated at a very high rate of speed and by cheap labor, as it is merely necessary for the operator to place the work right side up on the dial. These Waterbury-Farrel pillar presses are made in four sizes of the so-called short-stroke machines, and four sizes of a machine of practically the same design except with a long stroke. The two largest machines of the line can be furnished either plain or geared, as desired.

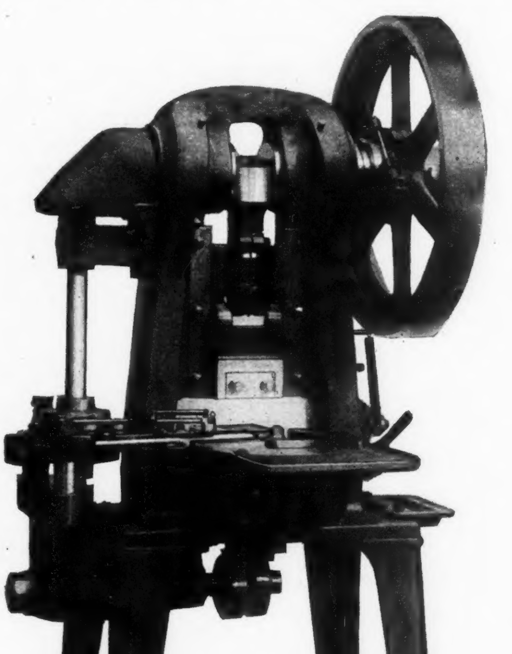
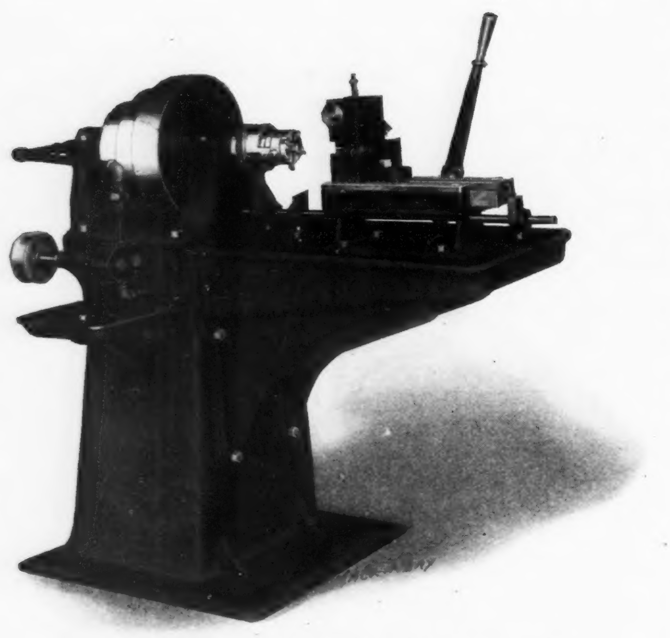


Fig. 4. Waterbury-Farrel Pillar Press equipped with Friction Dial

WEBSTER & PERKS THREADING MACHINE

The machine which forms the subject of this article was designed for the rapid and accurate threading of many parts, such as studs, rods and work of special shape, that are usually finished on screw machines. It is fitted with an adjustable self-opening die-head provided with adjustable front and rear stops; the front stop is employed to trip the die-head when the thread has been cut to any predetermined length, and the rear stop closes the head when the carriage has been returned by means of the hand lever. An automatic gripping holder is provided for use in connection with round stock studs or any similar work within its range. The holder grips the work automatically when the hand lever is pressed forward to bring the piece to be threaded into engagement with the die, and releases automatically when the carriage is returned to close the die. The carriage of the machine is also designed to permit of the ready application of special holding fixtures for handling odd shaped pieces.

Lubricant is supplied to the die-head by means of a geared oil pump which forces the oil through the hollow spindle; however, lubricant may also be supplied at the front of the die-head and delivered directly onto the work to be threaded. This machine has a range for U. S. standard threads from 1/4 to 5/8 inch, inclusive, but the maximum diameter may be exceeded on especially fine pitches. By employing reversing pulleys in place of the cone pulley, and suitable tapping chucks, this machine is admirably adapted for tapping parts that come within its range. The machine is a recent product



Threading Machine built by Webster & Perks Tool Co.

of the Webster & Perks Tool Co., Springfield, Ohio, and in addition to the single spindle machine illustrated, a two-spindle machine is also made.

IMPROVED PICOLET CIRCULAR SLIDE-RULE

The circular pocket slide-rule illustrated herewith has undergone marked changes in construction since its first appearance about a year ago. This rule consists of a disk 2¾

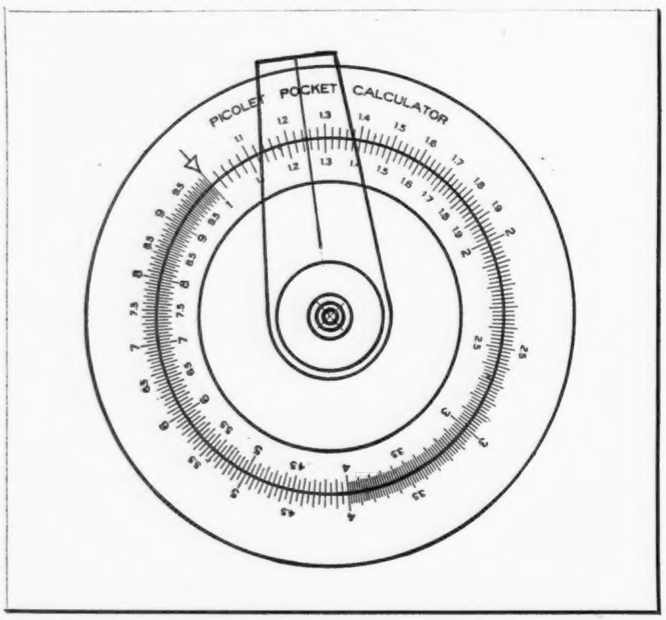


Fig. 1. Side of Circular Slide-rule commonly used for performing Operations of Multiplication and Division

inches in diameter by about ⅛ inch in thickness which has logarithmic scales graduated on both faces. Fig. 1 shows the side of the rule used commonly for performing the operations of multiplication and division. Referring to this illustration it will be seen that two direct reading logarithmic scales are provided. The inner scale is graduated on a small disk which can be rotated in relation to the main disk to provide for making the necessary settings of the scales. The transparent runner is held in frictional contact with the inner disk and provides a convenient means of rotating it relative to the larger disk.

Fig. 2 shows the graduations on the opposite side of the slide-rule, and referring to this illustration it will be seen that the large disk has an inverted logarithmic scale graduated on it and a direct reading scale inside the inverted scale. The small disk has an inverted scale graduated on it. The inverted scales afford a very convenient method of extracting cube roots, while the inverted scale on the small disk and the direct scale on the large disk are used for extracting square roots. A pamphlet is provided with each rule explaining the methods of performing these operations.

No change has been made in the arrangement of the scales on the rule, but noteworthy improvements have been made in its mechanical features. As first issued, the scales were printed directly upon pyralin, a material similar to and best known under the proprietary name of celluloid. They are now printed upon the underneath side of transparent thin pyralin, a milk-white backing bringing out the characters in excellent contrast. The scales are then mounted upon a disk of sheet steel and held together on the opposite faces of the steel disk by a narrow ring of cement around the edge. A

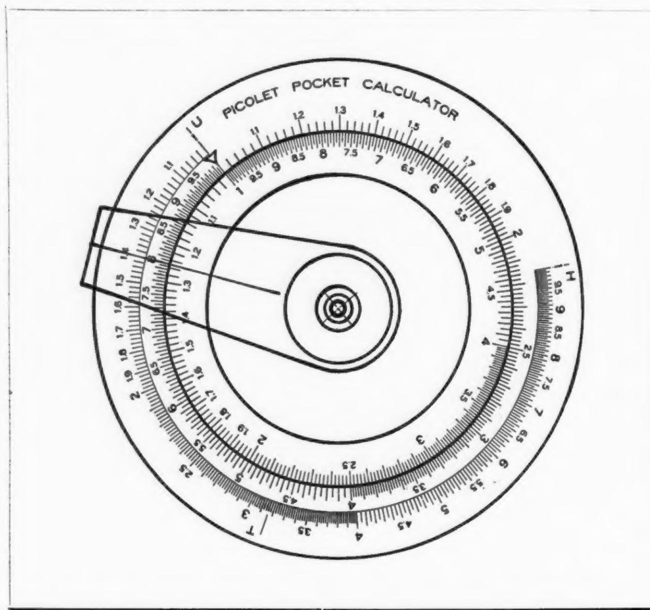


Fig. 2. Side of Circular Slide-rule used for extracting Square-roots and Cube-roots

cross-section of the instrument, with thicknesses exaggerated, is shown in Fig. 3. This mode of printing protects the scale, and the steel reinforcement prevents the warping that almost invariably occurs with cellulose material. The smaller disks are treated in the same way and are prevented from buckling by thin metal disks which cover them within a quarter inch of the edge. The divisions and centering are accurate and the rule is guaranteed for a precision equivalent to three-place logarithms. The rule is also made with either the direct or inverted scale on one face and the other left blank.

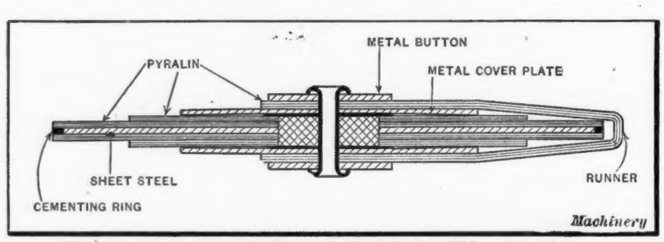


Fig. 3. Cross-sectional View of the Picolet Slide-rule showing Improvements in Construction

The dimensions are 2¾ inches in diameter by about ⅛ inch thick, and the rule is supplied in a round leather case. This slide-rule is made by Lucien E. Picolet, 19 South 9th St., Philadelphia, Pa.

M. B. HILL TOOL-HOLDER AND UNIVERSAL INDICATOR

The M. B. Hill Mfg. Co., Worcester, Mass., has recently added to its line a combination threading and cutting-off tool and the universal test indicator. These two tools are shown in the accompanying illustrations, and the following is a brief description of their more important features.

The tool-holder is offset at an angle of 30 degrees, which prevents interference when it is used for threading short

work. This construction also enables the cutting-off tool to be set close to the chuck when engaged in cutting off stock. The blades are made of high-speed steel and

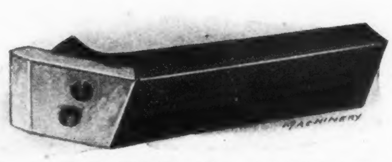


Fig. 1. M. B. Hill Threading and Cutting-off Tool-holder

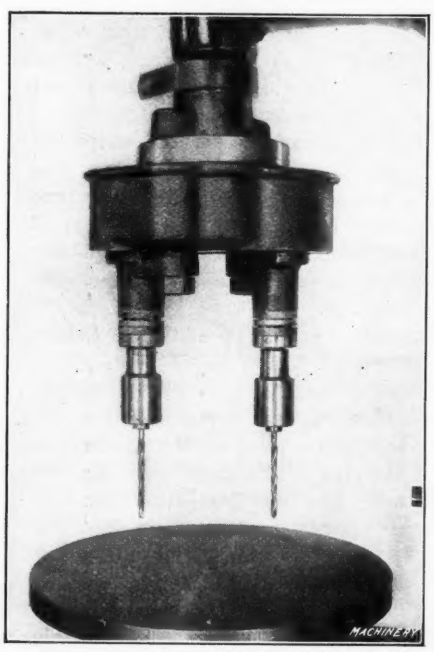
held rigidly to the shank of the tool, which is made of ½ by 1 inch stock.

Fig. 2. Hill Universal Test Indicator

The universal test indicator is used for testing the truth of work in the lathe, drill press or planer according to the usual methods employed in using an instrument of this type. When mounted in the toolpost, the indicator can be used in any position, as the head swivels in every direction. The graduations read to 0.001 inch when used either externally or internally. The indicator is sensitive in action, but constructed in such a way that it will not be easily injured. The shank upon which the instrument is mounted is 7/16 by 7/8 inch in size.

SELLEW ADJUSTABLE DRILL HEAD

The two-spindle adjustable drill head illustrated herewith has been designed and placed on the market by the Sellew Machine Tool Co., Pawtucket, R. I., for use on sensitive drilling machines. The head is adjustable, its range being from 1 to 3½ inches center distance between the spindles. As the drill spindles of this head run much faster than the spindle of the drilling machine, the head is suitable for driving small drills.



Sellew Two-spindle Adjustable Drill Head

An interchangeable sleeve connects the drill head to the quill of the drilling machine in such a way that it can be adjusted around the spindle in order to have the center line of the drill chucks stand in any desired location. Owing to the arrangement of the spindles when they are adjusted in any location from the minimum to the maximum, the pressure of the feed cannot produce undue friction and heat in the head. The spindles and gearing are of alloy steel and bronze bushings or ball bearings are employed. All gearing is enclosed to provide for the safety of the operator. This drill head is made in three sizes and fitted with either solid or adjustable chucks or with Morse taper spindles, as desired.

SLOAN & CHACE AUTOMATIC LATHE

The small automatic lathe, front and rear views of which are illustrated in Figs. 1 and 2, is intended for machining small tapered bushings which are ½ inch in length by ⅝ inch in diameter at the large end. The Sloan & Chace Mfg. Co., Ltd., Sixth Ave., corner 13th St., Newark, N. J., builds a great variety of special metal working machines, and this is an example of an equipment of this kind recently designed and built in the company's shops. The operation of the machine is controlled entirely by cams, so that it is merely necessary for the operator to feed the blanks in at the top of the chute. As a result, the cheapest kind of labor can be used with satisfactory results. The output of the machine is eight or nine pieces per minute, and the results obtained have been so satisfactory that the Sloan & Chace Mfg. Co. intends making this machine as a regular product.

It will be evident from the illustrations that the head is driven by the usual form of cone pulley, and the taper of the work is obtained by means of a special tool-slide, the design of which is somewhat similar to the familiar form of taper attachment used on engine lathes. The five cam movements which control the traverse of the tool-slide, the feeding of the work and the opening and closing of the chuck, are driven from the pulley seen at the left-hand end of the machine in Fig. 2. The cycle of operations performed by the machine consists of taking a blank from the chute and transferring it to the chuck, closing the chuck on the blank and feeding the tool across the blank, then opening the chuck and ejecting the finished piece of work. The way in which these operations

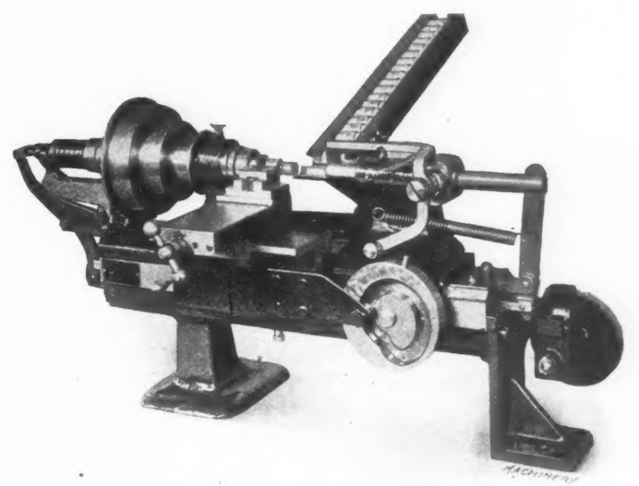


Fig. 1. Front View of Sloan & Chace Automatic Lathe

are performed may be briefly described as follows: Referring to Fig. 1, it will be seen that there is a pin mounted in the edge of the positive cam located at the front of the machine. When this pin engages the roller at the lower end of the lever which holds the blanks in the feed chute, this lever is swung about its pivot against the tension of a coiled spring, and allows one blank to drop out of the chute. As soon as the pin has passed under the roller at the lower end of the feed lever—which allows just enough time for one blank to drop out of the chute—the lever descends and holds the rest of the blanks up in the chute.

The next step is to convey the blank over to the chuck, which is open at this point in the cycle. This is accomplished by means of the horizontal plunger which moves over and pushes the blank into the chuck. This plunger is held back during the remainder of the cycle by means of a cam which releases it at the proper time so that the spring may pull it to the left, Fig. 1, and convey the blank to the chuck. With the blank in place in the chuck, the tool-slide begins to feed

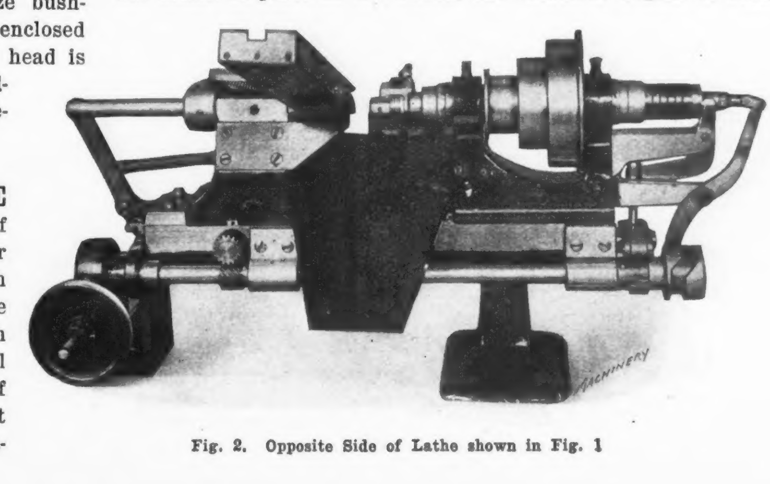


Fig. 2. Opposite Side of Lathe shown in Fig. 1

to the left, through the action of a coiled spring, which moves it under control of the feed-cam, and in this way the work is turned to the required taper through the action of the special tool-slide with which the machine is equipped.

After the turning of the blank has been completed, the positive cam shown at the front of the machine in Fig. 1 starts to return the tool-slide to the starting point; and at the same time, the edge-cam located near the right-hand end of the horizontal cam-shaft in Fig. 2 raises a plunger into contact with the pivoted lever which controls the action of the collet chuck. This lever works against the tension of a coiled spring and opens the chuck, after which the barrel cam at the extreme end of the horizontal cam-shaft is able to operate the ejector rod to remove the finished work from the chuck. This sequence of operations is performed with the utmost smoothness and regularity and, as previously stated, the only attention which the machine requires is to have the blanks fed into the chute. A girl of average intelligence is able to handle this work.

LINDERMAN UNIVERSAL MACHINE TOOL

In engine rooms, experimental shops, on board ship, in garages, etc., there is need for a small machine shop, but lack of space frequently makes it necessary for the machine work to be sent out. Such a method of procedure is unsatisfactory because the cost of the work is high and the delay incident to sending the work to the jobbing shop, explaining what is to be done and then waiting for the work to be turned out, means serious inconvenience. To meet the requirements of this field, the Linderman Machine Co., Muskegon, Mich., has brought out a universal machine tool comprising a lathe, drill press, shaper, milling machine and keyseater. This machine is 11 feet long by 22 inches wide; and the floor space occupied is 20 square feet. It is stated that this machine meets all requirements of individual machines of the types which it comprises, and the floor space required is obviously much less. The machine is driven by an individual motor, so it is self-contained and installation is simplified as far as possible. If necessary, three men can work at this machine at the same time.

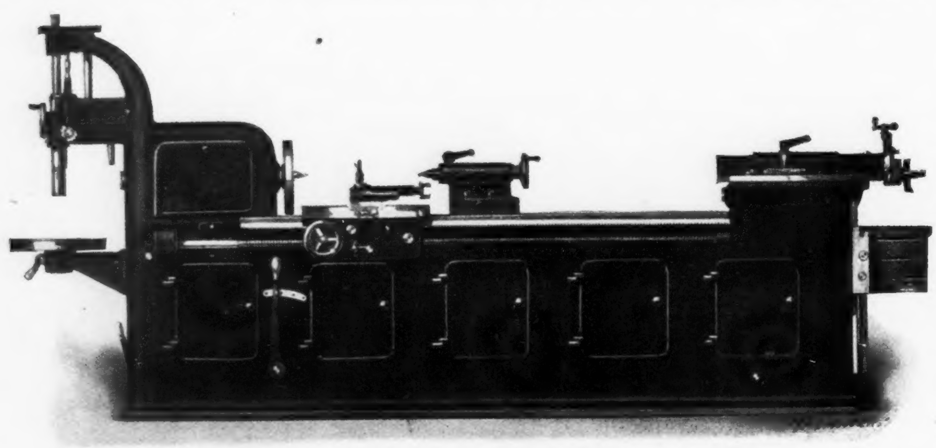


Fig. 1. Linderman Universal Machine Tool arranged for the Lathe, Drill Press, Shaper Combination

Fig. 1 shows the machine arranged for the drill press, lathe and shaper combination. In Fig. 2 the machine has been converted into the drill press, lathe and milling machine combination. Referring to this illustration, it will be seen that the shaper ram has been fitted with outboard support for the milling machine arbor, and that an auxiliary table has been fitted on the shaper table. The drive to the milling machine spindle is through a shaft from the lathe spindle, which is geared to the milling machine spindle as shown. In addition, the machine can be arranged for the combination of drill press, lathe and keyseater.

The principal dimensions of the lathe are as follows: Distance between centers, 44 inches; swing in gap, 24 inches; swing over carriage, 10 inches; diameter of large faceplate, 13¾ inches; diameter of small faceplate, 8 inches; cuts any standard thread from 3 to 24 per inch, including 11½ threads per inch. The headstock is of the all-geared type with the gearing enclosed, and eight changes of speed are provided. The lathe is equipped with a compound rest and set-over tailstock.

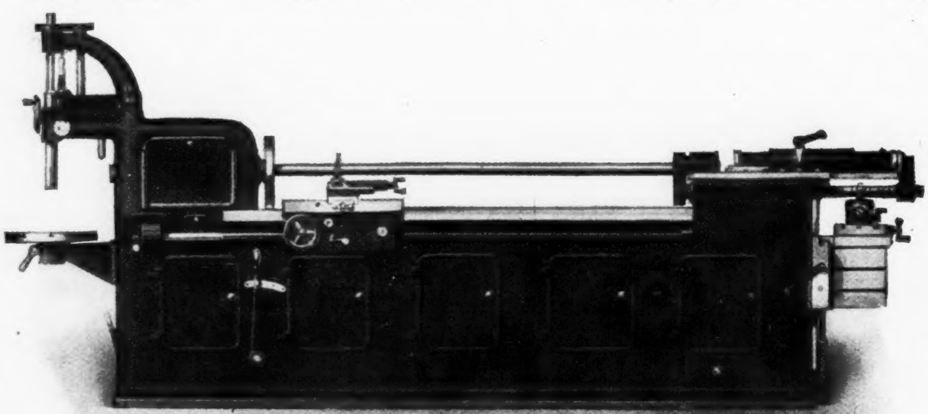


Fig. 2. Linderman Universal Machine Tool arranged for the Lathe, Drill Press, Milling Machine Combination

The drill press has a capacity for drilling holes from ⅛ up to 1½ inch in diameter, and drills to the center of a 20¼-inch circle. The movement of the spindle is 8 inches and the hole in the spindle is No. 3 Morse taper.

The extreme length of stroke available on the shaper is 14 inches and the cross motion of the table 19 inches; the vertical adjustment of the table is 14 inches. The distance between the table and the ram is 16 inches and the feed of the tool-block 4 inches. The table is 15 by 11 inches in size and the tilting table may be set at any angle between zero and 90 degrees.

The keyseater has a stroke of 14 inches and a maximum keyseating capacity of 8 inches. The work is held in the lathe chuck, and the keyseating bar is guided by a support held in the toolpost. The keyseating bar is actuated by the shaper ram, and the feed of the keyseating tool is through the cross-slide.

The shaft which transmits power from the lathe head to the milling machine is back-geared in a ratio of 2 to 1. The milling machine table has a transverse feed of 14 inches, a lateral feed of 4 inches, and a vertical feed of 14 inches. The distance between the table and the spindle may be from 3 to 14 inches, and a dividing head may be provided for handling those classes of work for which it is required.

The following outlines a few of the operations that can be conveniently handled on this machine. Pulleys or gears up to 24 inches in diameter may be turned, bored, faced and keyseated at a single chucking. Nuts and bolts of practically any diameter and thread may have the thread cut in them. Pipe and fittings up to 8 inches in diameter may be cut off and threaded. Keyways up to ⅝ inch wide by 13 inches in length may be cut. Both internal and external grinding may be handled with the grinding attachment; and the machine may be conveniently used for profiling cams of various forms. One slot may be milled lengthwise and another slot shaped crosswise at a single chucking of the work.

Where a dividing head attachment is provided, spur or bevel gears may be cut. These are but a few typical operations which will tend to show the wide range of work for which this machine is adapted.

REED-PRENTICE FOUR-WAY DRILLING MACHINE

This special four-way drilling machine was designed and built for the Ford Motor Co., Detroit, Mich., for use in drilling four holes simultaneously in universal joint rings. The rings are held in individual fixtures, several of these fixtures being used with the machine so that while one ring is being drilled, a blank may be put in another fixture ready for the subsequent drilling operation. After the four holes have

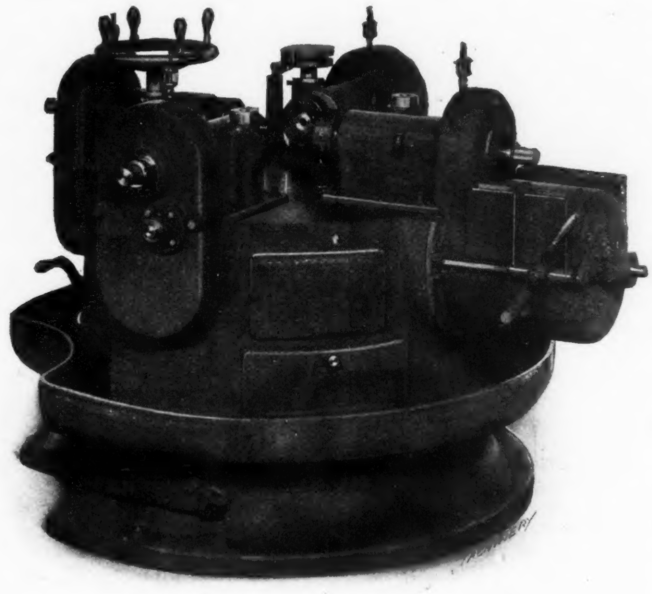


Fig. 1. Reed-Prentice Four-way Drilling Machine for drilling Universal Joint Rings

been drilled, the main fixture on the machine is unloaded and another ring—already clamped in a subordinate fixture—is re-loaded into the main fixture, after which the machine is again ready for operation. The spindles are driven from a main driving pulley located at the side of the machine and power is transmitted to each of the four spindles through spur gears, shafting and bevel gears.

The heads are rigidly held to the main base of the fixture to maintain the alignment of opposite holes and to have the adjacent holes as nearly at right angles to each other as possible. The feed mechanism is of the rack and pinion type, power being delivered to each of the spindles by a bronze worm-wheel and hardened steel worm. The trip mechanism acts on the "drop worm" principle. In order to start the feed, a lever which is conveniently located at the operator's left hand brings the worm and worm-wheel into mesh. When the spindles have traveled in the required distance, an automatic knockoff cam located at the top of one of the rack pinions, engages the trip rod and automatically disengages the feed mechanism. The spindles are then returned to their original or starting positions by the operator, who can control the return by the wheel shown in the head at the left-hand side of the machine.

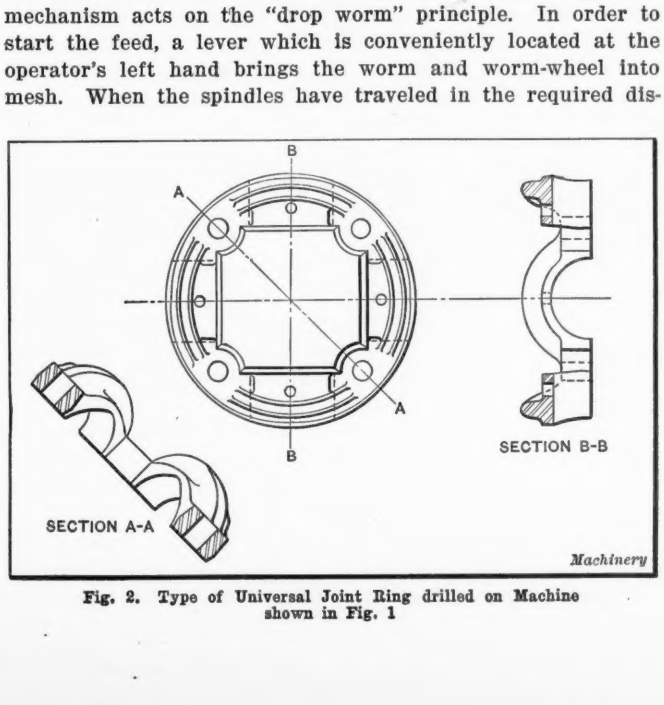


Fig. 2. Type of Universal Joint Ring drilled on Machine shown in Fig. 1

The driving gears of this drilling machine are all of the helical type and all bearings are bushed with phosphor-bronze. Wherever it is feasible, the shafts are provided with double support. The problem of lubrication is well taken care of by a pump and piping which leads to each individual bearing and provides a copious supply of oil. This system keeps the bearings clean at all times; the surplus oil drains back to a main reservoir, where it is filtered before again being pumped through the machine. The floor space occupied is 6 feet 6 inches by 5 feet 6 inches and the weight of the machine is approximately 7000 pounds. The Reed-Prentice Co., Worcester, Mass., is the manufacturer of this machine.

NEW MACHINERY AND TOOLS NOTES

Knurling Head: National-Acme Mfg. Co., Cleveland, Ohio. A knurling head adapted for use in one of the regular self-opening die-heads of this company's manufacture. The knurls are mounted in holders which are inserted in the head in place of the usual chasers.

Weight Calculating Instrument: Pittsburg Instrument & Machine Co., Pittsburg, Pa. This device was developed to provide a means for rapidly and accurately determining the weight of car wheels, gear blanks, dies and other circular metal parts from the drawings.

Punch Press Safeguard: H. & A. Lock Co., 156 Fifty-third St., Brooklyn, N. Y. An improved type of the duplex punch press safeguard which is styled the "duplex superior." This is really a simplified combination of the simplex and duplex safety attachments made by this company.

Set-screw Lock-nut: Hollow Screw Co., 41 Park Row, New York City. This set-screw is used for locking the ordinary type of socket safety set-screw in place. The lock-nut is of similar design to the set-screw but shorter, and is screwed down on top of the screw in the usual way.

Hob Grinder: Union Twist Drill Co., Athol, Mass. The hob to be sharpened on this grinder is mounted on an arbor which is carried by a center in the headstock spindle and supported at the outer end by the tailstock center. Index plates for any number of flutes from 5 to 14 are provided.

Gasoline Torch: Decker Mfg. Co., Newark, N. J. A torch designed to operate on the principle of liquid expansion. By filling the priming cup on top of the container and lighting the gasoline, the heat is carried to the gasoline in the container, causing it to expand and create a natural pressure.

Hold-down for Thin Work: Ready Tool Co., 223 Water St., Bridgeport, Conn. A positive spring hold-down particularly adapted for securing thin work in the vise of the shaper or milling machine. This device consists of three parts, *viz.*, the holder, the triangular clamping piece, and the springs.

Arbor Press: Lourie Mfg. Co., Springfield, Ill. An arbor press equipped with a differential hydraulic pump which has two pistons of unequal size. When the pressure becomes heavy, the larger piston is automatically disengaged and heavier pressures are then easily obtained by working the small piston.

Tap and Reamer Wrench: Russell Mfg. Co., Greenfield, Mass. An adjustable wrench for holding taps and reamers, the body of which is drop-forged steel, casehardened and fitted with tempered tool steel jaws. The handles are made of steel tubing and are knurled to afford the operator a good grip on them.

Electric Welder: National Electric Welder Co., Warren, Ohio. A flue welding machine which has a capacity for welding tubing from 1¼ to 3 inches in diameter. Such material as round or square steel bars from ½ to 1¼ inch in diameter can also be handled on this machine when equipped with suitable clamping dies.

Gages: Union Twist Drill Co., Athol, Mass. Gages for testing rotary cutters to provide for having each tooth cut to an equal depth. These gages were originally developed for use in the shops of the Union Twist Drill Co., but the increasing demand for tools of this kind has led to their being placed on the market.

Machinists' Small Tools: Union Caliper Co., Orange, Mass. Recent additions to the line of small tools manufactured by this company consist of a quick-adjusting spring caliper, an adjustable boring-bar and a keyseat rule block. These tools have features which will doubtless commend them to the progressive mechanic.

Motor Truck Crane: Brown Hoisting Machinery Co., Cleveland, Ohio. A one-ton pillar jib crane carried on a motor truck built by the Peerless Motor Car Co., of Cleveland, Ohio. This crane enables heavy loads to be lifted to and from the truck with the greatest facility. The crane is adaptable for use on any motor truck.

Punch Press Safeguard: Yale & Towne Mfg. Co., 9 E. Fortieth St., New York City. This guard was originally developed for use in the plant of the Yale & Towne Mfg. Co., where a strenuous accident prevention campaign has been carried on. The device has not been patented and anyone who desires to use it may do so.

Gap Lathe: Putnam Machine Co., Fitchburg, Mass. A double back-geared sliding gap lathe which swings 18 inches over the bed and 36 inches in the gap. This machine is also built in two other sizes, one of which swings 22 inches over the bed and 46 inches in the gap, while the other swings 28 inches over the bed and 57 inches in the gap.

Square Swivel-base Vise: Skinner Chuck Co., New Britain, Conn. This vise is intended for use on the shaper, planer or milling machine, but is especially adapted for shaper work. It has a square base with four slots for bolting it to the table of the machine. The upper section of the sub-base is graduated to enable the operator to set the vise to any required angle.

Counterbore: Eclipse Interchangeable Counterbore Co., Detroit, Mich. A counterbore of simple design which consists of a holder provided with the usual form of shank and tang to fit into the spindle of the machine. The cutter is made with a shank to fit into the socket of the holder and different cutters may be easily mounted in the holder ready for use.

Bench Lathe: Dalton Machine Co., 108-110 E. 129th St., New York City. A 6-inch bench lathe which has a capacity for taking work up to 13 inches in length between centers. The cross-slide travels 5½ inches and the compound rest 2⅝ inches. The length of the bed is 30 inches. The machine will cut screws with from 3 to 140 threads per inch, including 11½ threads per inch.

Foot Press: Ferracute Machine Co., Bridgeton, N. J. A small foot press mounted on a conical shaped pedestal instead of the usual four legs. The height from the bed to the ram at the top of the stroke and adjustment is 6 inches. The depth of the throat back from the center of the ram is 4½ inches and the bed is 8 inches in diameter with a 3-inch round hole in the center of it.

Multiple Punch Press: Rockford Iron Works, Rockford, Ill. This press has a capacity for work up to 75 inches long by 5 inches wide. It consists of two Rockford presses mounted on a base to which a heavy bed-plate is attached. The dies are assembled in this bed-plate in any desired position. The punch-holder is of similar construction to the bed-plate and counterbalanced.

Acetylene Generator: Vulcan Process Co., Minneapolis, Minn., and Cincinnati, Ohio. A generator designed for use in connection with autogenous welding outfits. The feature of the equipment is the extreme simplicity of its design. The carbide feed is so arranged that the amount of carbide delivered to the water can be accurately regulated and varied according to the amount of gas being used.

Portable Hoist: Ingersoll-Rand Co., 11 Broadway, New York City. A portable hoist known as the "Little Tugger" which is intended for light lifting and hauling, the capacity being up to ½ ton. The weight of the hoist is only 300 pounds, so it is especially suitable for contract work, for use in manufacturing plants, railroad shops, etc., where it is required to move the hoist from place to place.

Punch Press: Loshbough-Jordan Tool & Machine Co., Elkhart, Ind. The ram of this machine is provided with a square opening to receive punch shanks of various sizes. The press is of the inclinable type, the inclining mechanism consisting of a worm and worm-wheel. A safety bolt is provided, which prevents tripping the press while the operator is setting the dies. The bearings on the machine are self-oiling.

Car Wheel Boring Machine: Putnam Machine Co., Fitchburg, Mass. This machine is built in two sizes which have capacities for handling work up to 42 and 52 inches in diameter, respectively. The boring spindle has an exceptionally long traverse so that the cutter-bar can be drawn up within the spindle bearing to avoid damage to the cutters when placing work in position or removing it from the machine.

Power Hacksaw: W. Robertson Machine & Foundry Co., 32 Greenwood Place, Buffalo, N. Y. The noteworthy feature of this machine is that the entire mechanism is mounted on a swivel base so that it may be set for cutting work at any desired angle. This marks a decided improvement over the use of a swivel vise, because when cutting long pieces of work the use of a swivel vise necessitates a large amount of room around the machine.

Power Press Safeguard: Superior Tool, Die & Stamping Co., 2396 Silver St., Brooklyn, N. Y. This safeguard consists of a movable arm operated by the clutch rod of the press, with a narrow band at its end which fits around the punch. This band acts in the double capacity of a stripper and a guard. In the event of the operator leaving his hands on the die, the band cannot drop down into place, and as a result the press cannot be tripped.

Punch Press Guard: Charles Seitz, Albany, N. Y. This guard consists of a stationary rod clamped to the left-hand side of the press and a movable rod carrying flexible chains secured to a lever pivoted at the right-hand side of the press. A connecting link connects the short end of the lever to the treadle rod. When the lever is depressed, the movable rod is raised to within ½ inch of the stationary rod before the clutch is engaged. It is impossible to engage the clutch while the operator has his hands on the die.

Tapping Chuck and Tapping Attachment: Peter Bros. Mfg. Co., Algonquin, Ill. These are two products which were formerly manufactured by the Woodstock Safety Chuck Co., Woodstock, Ill. The turning resistance of the tapping chuck is obtained by the combination of an adjusting nut, a spring, and male and female friction cones. The taps are driven in the usual way by the square end. The tapping attachment provides for handling tapping operations on drill presses which are not provided with a reverse motion.

Automatic Screw Machine: Cincinnati Automatic Machine Co., Cincinnati, Ohio. A five-spindle automatic screw machine which can be so easily set up that it is claimed that it may be used advantageously in producing small lots of work. The method of shifting from right- to left-hand thread cutting is very simple. The tools are returned positively before the head is indexed, thus preventing accidents in case the contact spring fails to operate. Changes of speed are easily made and plates fastened to the speed-boxes give all the necessary information.

Multiple Punch and Spacing Table: Hilles & Jones Co., Wilmington, Del. A multiple punching machine built for the passenger car department of the Harlen & Hollingsworth Corporation of Wilmington, Del. The machine has a capacity for punching eighteen holes 9/16 inch in diameter at one stroke through a ¼-inch steel plate. The distance between the housings is 50 inches and the machine is driven by a 20-horsepower motor. The machine is equipped with a Thomas spacing table and control mechanism furnished by the Standard Bridge Tool Co. of Pittsburg, Pa.

Heavy Double Crank Power Press: Cleveland Machine & Mfg. Co., 4944 Hamilton Ave., Cleveland, Ohio. In the December, 1913, number of MACHINERY one of a line of double crank presses manufactured by this company was illustrated and described. A larger machine of very similar design is now being built, the frame of which consists of four pieces held together with heavy steel tie rods. The length of the housings can be varied to suit individual requirements, giving a maximum die space of 72 inches between the bed and the slide. Where the extreme die space is required, a special connection is provided which permits adjustment of the slide through the whole die space and eliminates the necessity of using auxiliary bed plates, ring bolsters, etc., when the press is used in connection with dies of normal height. The slide ways of this machine are extended so that the slide never overhangs its bearings. The machine is equipped with a powerful multiple disk friction clutch which is enclosed so that there are no revolving parts exposed. The adjustment is universal on all levers, and the brake arms are operated by a pair of toggle links. The clutch is controlled by a hand lever conveniently located for the operator.

* * *

BRASS MACHINE PARTS MADE BY HYDRAULIC PRESSURE

A method has recently been developed in Germany for producing small brass machine parts, plumbers' brass fittings and similar products by hydraulic pressure. This method is intended to replace casting such parts and has many points to commend it where the number of pieces to be made is sufficient to warrant the expense of making the necessary dies. In the first place, the high pressure under which the work is formed serves to compress the metal and materially increase its strength; second, defective work resulting from blowholes, etc., is avoided, which means a saving in material and labor; third, the finish of the work is such that in many cases it requires no subsequent machining. It is stated that shops that are using this method find it cheaper to produce work in this way than by casting. R. F. Lang, 8-10 Bridge St., New York City, is the sole agent for this process in the United States and Canada.

NINTH ANNUAL FOUNDRY AND MACHINE EXHIBIT

WORLD'S RECORD MADE IN DRILLING STEEL—EXHIBITORS AND EXHIBITS IN THE MACHINERY FIELD

THE annual convention of the Allied Foundrymen's Associations and the Ninth Annual Foundry and Machine Exhibit was held in Chicago from September 5-11, inclusive. The Allied Foundrymen's Associations include the American Foundrymen's Association, which convened at the Hotel La Salle, the American Institute of Metals, which was also in convention at the Hotel La Salle, and the Associated Foundry Foremen, who made their headquarters at the Fort Dearborn Hotel. During the week each of these organizations heard a number of exceptionally interesting papers read by their members.

On Monday no executive meetings were held, the day being set apart for registration at the respective headquarters of the three organizations which constitute the Allied Foundrymen's Associations. On Tuesday morning all three organizations met at the Hotel La Salle, where an address of welcome was delivered by H. O. Lange, chairman of the general committee. President Alfred E. Howell of the American Foundrymen's Association, President G. H. Clamer of the American Institute of Metals, and President S. V. Blair of the Associated Foundry Foremen then made their annual addresses in the order named. Following these opening exercises, the morning was given over to the reading of papers dealing with different methods of insuring safety and sanitation in the foundry. During the remainder of the week, a number of papers of exceptional interest and value to men in their respective industries were read. The subjects dealt with comprised methods of cost-keeping in the foundry, the application of scientific management in foundry practice, methods of calculating metal mixtures, steel foundry practice, modern die-casting practice, the nomenclature of alloys, modern practice in brass founding, and a number of other subjects.

The feature of the meeting of particular interest to readers of MACHINERY was the Ninth Annual Foundry and Machine Exhibit which was held in the International Amphitheatre. The exhibit was one of exceptional interest and was marked by an unusually representative gathering of manufacturers of equipment for the various branches of foundry and machine shop work. Coming at a time when European complications have depressed our manufacturing activity, it was remarkable to note the spirit of optimism shown by the majority of the visitors. Many of the exhibitors reported orders taken at the exhibition and others found "prospects" which ought undoubtedly to develop into future orders. The visitors at the exhibition are connected with a great variety of industries and should be in a position to express reliable opinions in regard to the probable course of industrial progress during the coming year. If the consensus of opinion expressed by these men is accurate, there should be little doubt of the coming of a marked improvement of conditions at an early date.

A test of twist drills was made on a Colburn drilling machine, exhibited by the Colburn Machine Tool Co., Franklin, Pa. This machine was driven by a 25-horsepower Westinghouse motor running at 1100 revolutions per minute. Tests were made on steel 35-40 point carbon and cast iron. The steel block 4¼ inches thick was successfully drilled with a 1½-inch drill running at 343 revolutions per minute, feeding 0.061 inch per revolution, the rate of penetration being 20.92 inches per minute. This is believed to be the world's record for rapid drilling in steel. In drilling cast iron, a drill 3 inches diameter drilled through the block at the rate of 343 revolutions per minute, feeding 0.061 inch per revolution, the rate of penetration being 20.92 inches per minute in this case also.

The following gives a list of the more prominent exhibitors in the machinery field and the products that were shown.

Acme Machine Tool Co., Cincinnati, Ohio, "Cincinnati-Acme" geared head flat turret lathe, motor-driven.

American Tool Works Co., Cincinnati, Ohio. Tool-room lathe; motor-driven lathes; universal shaper; motor-driven shaper; planers; and plain radial drill, motor-driven.

Armstrong-Blum Mfg. Co., Chicago, Ill. Power hacksaw machines, hand-lever shears, hand-lever punches, hand-lever rod cutters, drill press vises.

E. C. Atkins & Co., Indianapolis, Ind.

Baker Bros., Toledo, Ohio. Heavy-duty ball-bearing high-speed drilling machine; keyway cutting machine for cutting internal keyways and miscellaneous slotting; and gear box for demonstrating gear shift.

Barber-Colman Co., Rockford, Ill. Hobs, hobbing machine, and milling cutters.

Barnes Drill Co., Rockford, Ill. All-geared drill press with positive oiling device.

Benjamin Electric Mfg. Co., Chicago, Ill. Benjamin safety and efficiency devices for punch presses; factory signal systems; and industrial lighting fixtures.

Charles H. Besly & Co., Chicago, Ill. Besly patternmakers' disk grinder (motor-driven); "Helmet" cement; "Helmet" oil; "Helmet" spiral circles; and "Helmet" pressed-steel ring wheel chuck.

Brown & Sharpe Mfg. Co., Providence, R. I. Heavy plain milling machine; plain grinder; automatic screw machine; universal milling machine and cutters; and small tools.

Carborundum Co., Niagara Falls, N. Y. Carborundum and aloxite products in the form of wheels, rubbing bricks, sharpening stones, paper and cloth.

Central Iron Works, Quincy, Ill. Cuts, photographs, drawings and descriptive matter of latest improved tumbling mills, water cinder mill, combination brass cinder mill and casting tumbler; patented screen-cleaning device; dust arrester; sand-blast machines; exhaust fans; and air compressors.

Chicago Pneumatic Tool Co., Chicago, Ill. Pneumatic hammers; drills; and "Little Giant" drills and grinders.

Chicago Pulley & Shafting Co., Chicago, Ill. S. K. F. ball bearings; and steel pulleys.

Chicago Steel Foundry Co., Chicago, Ill. Steel castings; cast-steel flasks; and wire-rope sockets.

Cincinnati-Bickford Tool Co., Cincinnati, Ohio. Cincinnati high-speed, shaft-driven upright drill; and Cincinnati-Bickford regular plain radial drill.

Cincinnati Milling Machine Co., Oakley, Cincinnati, Ohio. Plain, high-power milling machine; universal cone machine; and cutter and tool grinder.

Cincinnati Planer Co., Cincinnati, Ohio. Heavy-pattern Cincinnati planer, with two heads on the cross-rail and two side heads, equipped with 15-horsepower General Electric reversible motor drive and rapid power traverse to the rail heads.

Cincinnati Pulley Machinery Co., Cincinnati, Ohio. "Avey" high-speed ball-bearing drill presses, motor-driven.

James Clark, Jr., Electric Co., Inc., Louisville, Ky. Direct-driven drill; friction-driven drill; bench grinder; power hacksaw and floor grinder; combined wet and dry grinder; bench grinder; jeweler's sensitive drill; portable drills; center grinders; and assortment of miscellaneous tools.

Cleveland Pneumatic Tool Co., Cleveland Ohio. Pneumatic drills; riveting hammers; chipping hammers; portable grinders; valve grinders; wood-boring machines; bench grinders; air hose; and air hose couplings.

Coburn Trolley Track Mfg. Co., Holyoke, Mass. Two different types of overhead monorail systems, together with motion pictures illustrating their application.

Colburn Machine Tool Co., Franklin, Pa. High-speed, heavy-duty drill press, motor driven; and a vertical boring mill, motor-driven.

Cowan Truck Co., Holyoke, Mass. Cowan transveyors; and new storage battery transveyor.

Curtis Pneumatic Machinery Co., St. Louis, Mo. Foundry crane mounted on crane runway; jib crane; overhead trolley system, including main and divergent tracks; trolleys; switches; and cross-overs. Vertical, single-stage, double-cylinder, Curtis air compressor in operation; and one vertical,

single-stage, double-cylinder Curtis air compressor; also one balanced pressure air hoist in operation; and two types of sand blast.

Diamond Machine Co., Providence, R. I. Heavy shop face grinder, motor-driven; automatic surface grinder, motor-driven.

Joseph Dixon Crucible Co., Jersey City, N. J. An assortment of crucibles and miscellaneous refractory articles.

Atlas Press Co. (G. T. Eames Co.), Kalamazoo, Mich. Compound mandrel or arbor presses.

Edgemont Machine Co., Dayton, Ohio. Extended sleeve friction clutches; countershaft friction clutches; and gas engine friction clutches.

E. L. Essley Machinery Co., Chicago, Ill., representing the American Tool Works Co., Diamond Machine Co., International Machine Tool Co., Colburn Machine Tool Co., the Cincinnati Pulley Machinery Co., Barnes Drill Co., Skinner Chuck Co., and G. T. Eames Co.

Flexible Steel Lacing Co., Chicago, Ill. "Alligator" steel belt lacing; "Alligator" tape fasteners for printers' tapes; and a standard testing machine for demonstrating tensile strength of "Alligator" fasteners.

Gardner Machine Co., Beloit, Wis. Vertical and horizontal disk grinders; band-polishing machines; patternmaking disk grinders; sand-roll pattern machine; buffing lathes; surface grinders; band wheels; ring-wheel chucks; abrasive disks; disk materials; disk grinder supplies; and Gardner hard oil.

Garvin Machine Co., New York City. Monitor lathe; and automatic tapping machine.

General Electric Co., Schenectady, N. Y. Centrifugal air compressor; portable arc welding set; high-efficiency incandescent lamps and fixtures; crane motor with solenoid brake; and cabinet with display of motor parts.

Gisholt Machine Co., Madison, Wis. Automatic chucking lathe; universal tool grinder; solid adjustable reamer; adjustable boring-bars; tool-holders; and periodograph for getting accurate "time on the job" records.

Goldschmidt Thermit Co., New York City. Full line of carbon free metals and ferro alloys; welding equipment; and a large crankshaft welded by the thermit process. Demonstrations of welding high-pressure pipe.

Gould & Eberhardt, Newark, N. J. Eberhardt automatic gear hobbing machine; and Eberhardt "Invincible" shaper.

Greaves-Klusman Tool Co., Cincinnati, Ohio. All-geared-head engine lathe, with flexible motor drive, single-lever control of selective speed changes, with apron control of start, stop and reverse of spindle.

Heald Machine Co., Worcester, Mass. Wet cylinder grinder; wet ring grinder; chuck bench with testing outfit and four Heald magnetic chucks; wet internal grinder; wet rotary surface grinder; and drill grinder.

Hunter Saw & Machine Co., Pittsburg, Pa. Newton cold saw; saw sharpening machine; tooth grinder; inserted tooth saws; Higley type saws; Bryant type saws; high-speed tube saws; hot saw; high-speed friction saw; and Newton saws.

Independent Pneumatic Tool Co., Chicago, Ill. "Thor" piston air drills; flue rolling, reaming, tapping and wood-boring machines; pneumatic portable grinders; close-corner drills; pneumatic chipping, calking, flue beading and riveting hammers; and "Thor" electric drills.

International Machine Tool Co., Indianapolis, Ind. "Libby" new type heavy turret lathe, 7½-inch hollow spindle.

Keller Pneumatic Tool Co., Fond du Lac, Wis. Keller pneumatic, bench and floor rammers; chipping hammers; drills and appliances.

Julius King Optical Co., Chicago, Ill. "Saniglas" King's safety eye protectors; helmets for welders, etc.

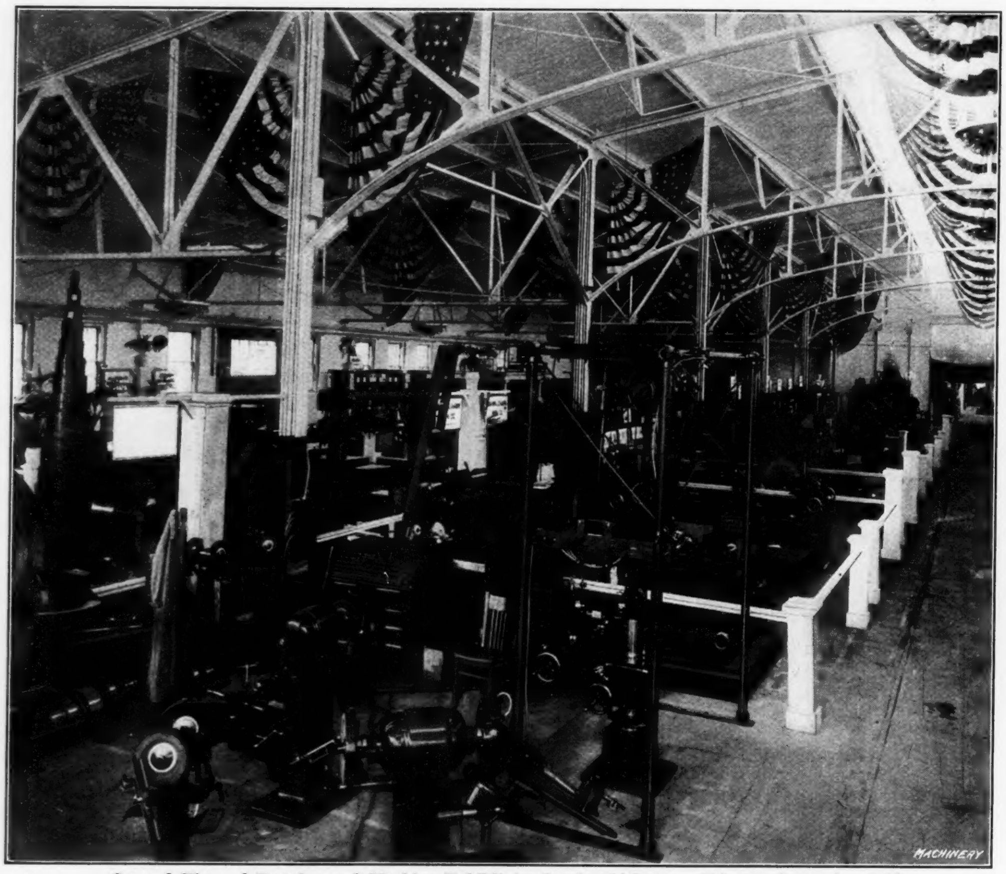
Landis Machine Co., Waynesboro, Pa. Single and double head bolt cutter; pipe die-heads; and automatic screw cutting die-head.

La Salle Machine & Tool Co., La Salle, Ill. La Salle plain and surface grinder with micrometer adjustment.

Lodge & Shipley Machine Tool Co., Cincinnati, Ohio. Selective head manufacturing engine lathe; and selective head universal tool-room lathe.

J. R. Long & Co., Akron, Ohio. Automatic forged-steel machinist's vises, pipe reamers and pipe cutters; and double and single swivel automatic vises.

MACHINERY, New York, N. Y. Collection of MACHINERY'S field service advertisements and photographs; MACHINERY'S mechanical books, including MACHINERY'S Handbook and new book on Spur and Bevel Gearing; MACHINERY'S Reference and Data Books.



General View of Foundry and Machine Exhibit in the Amphitheater, Chicago, September 5-11

Macleod Co., Cincinnati, Ohio. Buckeye sand blast tumbling barrel and revolving table; blacking swab sprayers; portable hose sand blast; and oxy-acetylene welding outfit.

Manufacturers' Equipment Co., Chicago, Ill. "Aero" chucks; collapsible taps and parts.

Marshall & Huschart Machinery Co., Chicago, Ill. "Acme" flat turret lathe; Baker high-speed drill; Baker keyseater; Cincinnati high-power, motor-driven milling machine, flooded lubrication; Cincinnati cone-type universal miller; Cincinnati cutter and tool grinder; Cincinnati-Bickford high-speed upright drill, also plain radial, motor-driven; Gould & Eberhardt gear hobber, also "Invincible" shaper with "Reliance" variable-speed motor; "Cincinnati" planer with reversible motor drive; Greaves & Klusman engine lathe, motor drive; Landis double-head bolt cutter, motor driven; Lodge & Shipley universal tool-room and selective-head manufacturers' lathes, motor driven; "Rockford" manufacturers' gang drill, motor

driven; "Monarch" engine lathe, geared head, motor driven; Richmond staybolt drilling machine, motor driven; Rivett bench lathe, complete; and Partridge grinders.

Metals Coating Co. of America, Chicago, Ill.; Schoop metal spraying pistol, with attendant equipment.

Monarch Machine Co., Sidney, Ohio. Standard single back-gear engine lathe; and an eight-speed, all-geared-head, motor-drive engine lathe.

Mott Sand Blast Mfg. Co., Chicago, Ill. Sand-blast barrel; sand-blast room, dust collector and fan; and sand-blast machine, hose type.

National Machinery Co., Tiffin, Ohio. "National" single bolt cutter; die sharpener; and open die-head.

Norton Co., Worcester, Mass. Grinding wheels; grinding machines; Norton grinding wheel floor stands in operation; and Norton grinding wheel bench stands in operation.

Oxweld Acetylene Co., Chicago, Ill. "Oxweld" welding and cutting blow-pipes; and other "Oxweld" apparatus.

Prest-O-Lite Co., Inc., Indianapolis, Ind. Oxy-acetylene welding and cutting apparatus; and portable acetylene gas cylinders.

General View of Foundry and Machine Exhibit in the Amphitheater, Chicago, September 5-11

Puro Sanitary Drinking Fountain Co., Haydenville, Mass. Drinking fountains.

Reeves Pulley Co., Chicago, Ill., and Columbus, Ind. Reeves wood split pulley; "American" steel split pulley; Reeves variable speed transmission; Alexander leather belting bond double-sure transmission line; Makutchan roller bearing; and "Rhineland" ball bearing.

Richmond Stay-Bolt Drilling Machine Mfg. Co., Inc., Richmond, Va. Stay-bolt drilling machines.

Rockford Drilling Machine Co., Rockford, Ill. Four-spindle, manufacturers' gang drill; and heavy-duty type drilling machine.

Rock Island Mfg. Co., Rock Island, Ill. Vises of all kinds, a type and size for every service.

Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. Three-ton capacity, cage-controlled, monorail, electric hoist; one-ton capacity, floor-controlled, high-lift type electric hoist; one-ton capacity, floor-controlled, A. C. electric hoist; five-ton capacity, electric traveling crane trolley; and back-geared electric motor with winch head.

S. K. F. Ball Bearing Co., New York, N. Y. Ball-bearing hangers, mounted on frame; various sizes of S. K. F. ball bearings; pillow blocks and hangers.

Skinner Chuck Co., New Britain, Conn. Full line of chucks, independent, combination and geared scroll; also drill chucks.

R. R. Street & Co., Inc., Chicago, Ill. Billings & Spencer tools; Hyatt roller bearings; Keystone steel pulleys; Slocomb micrometers; E. G. I. friction clutches; Brown utility vises; and Horton lathe and drill chucks.

Sullivan Machinery Co., Chicago, Ill. Sullivan air compressor, angle compound WJ-3 type; also single-stage, belt-driven type in operation; and Sullivan air compressor, steam driven, straight line, single-stage type.

Templeton, Kenly & Co., Ltd., Chicago, Ill. "Simplex" emergency jacks demonstrated under heavy load.

U. S. Electrical Tool Co., Cincinnati, Ohio. Electric drills and grinders.

Vanadium-Alloys Steel Co., Chicago, Ill. "Red-Cut" cobalt high-speed steel; "Red Cut" superior high-speed steel; and drills made of "Red Cut" superior high-speed steel.

Vulcan Engineering Sales Co., Chicago, Ill. Pneumatic and electric sand sifters; cold metal saws; air hoists, trolleys and suction lubricator.

Warner & Swasey Co., Cleveland, Ohio. Universal hollow hexagon turret lathe equipped for chucking work; universal turret screw machine equipped for bar and chucking work; plain head turret lathe with hexagon turret; automatic chuck and hand longitudinal feed for cut-off.

Weaver Mfg. Co., Springfield, Ill. Weaver roller jaw drill chucks; auto twin jacks; and garage presses.

Wernicke-Hatcher Pump Co., Grand Rapids, Mich. Rotary air compressors and receiver, with gages, etc.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Arc welding outfits; alternating-current motors; direct-current generators; and switchboards.

Whiting Foundry Equipment Co., Harvey, Ill. Electric crane trolley on structural frame; spur-geared tumbling barrel; section of standard drawer type core oven; and flat-top turntable.

Wilmarth & Morman Co., Grand Rapids, Mich. Wet surface grinder; universal cutter and reamer grinder; "New Yankee" drill grinders (all motor driven); combination wet tool and drill grinders; and combination cutter, reamer and drill grinder.

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MACHINE TOOLS FOR SPAIN

The Spanish government has entered the American market for immediate delivery of a great quantity of ordnance and rifle-making machinery. Inquiries have been directed by a large Madrid contracting firm representing the Spanish government to the Foreign Trade Bureau of the Philadelphia Commercial Museum. The firm making the inquiry furnishes all the factories of the war and navy department in Spain with machines and tools, and manufacturers of the following lines of machine tools are requested to enter into communication with the Foreign Trade Bureau of the Philadelphia Commercial Museum for the supply of this machinery. The classes specified are sensitive and upright drilling machines, gear-cutting machines, grinding and polishing machines, cold metal saws, punching and shearing machines, and machines for the manufacture of cartridges for Mauser rifles.

BUSINESS SITUATION IN THE CENTRAL AND WESTERN STATES

The business situation in the Central and Western States affecting the machine tool trade and closely related lines is much better than a few weeks ago, though yet far from normal, but the volume of orders recently placed indicates that the worst is over. Machine tool builders who have hardly received an order for months report more inquiries and some orders; some contracts have been closed on inquiries recently received from England. One machine tool builder in Milwaukee says, "We are running full force, full time, full equipment; orders are good and inquiries are better."

A number of the machine tool builders who exhibited at the Foundry & Machine Builders' Exhibition in Chicago have already closed orders on inquiries secured at the exhibition. The freight rate situation and the European war have unfavorably affected the railroads, making their apparent condition worse than ever before; but the Western railroads have an enormous grain crop to haul and must keep their rolling stock and motive power in condition for business. One railroad running into Chicago nursed along a list of tools approximating $100,000 for nearly eighteen months. The order was ready for final O. K. when an order was issued from headquarters to cut out every possible purchase. When the order for this list of tools will be placed is indefinite, but it is not likely to be acted upon this year.

Builders of agricultural machinery and implements are convinced that business conditions have improved with the moving of the grain crops. This happier feeling is also shared by the financial interests affected. The country banks will call less on the city banks for funds now that the grain is moving. This of course reacts favorably on the large financial interests which express the opinion that business is slowly but surely changing for the better. When the banker regains confidence and shapes the policy of his own bank accordingly, business begins to revive. The banker is the ultra-conservative—he is first to "view with alarm" and also the first to get the right view of conditions as they improve.

F. L. H.

* * *

EDISON TELEPHONE CONVERSATION RECORDER

Another interesting device has been added to the long list of inventions by Thomas A. Edison, called the "telescribe," an instrument for recording telephone conversations. It is used as an auxiliary to the Edison commercial phonograph or dictating machine, and enables the user to record both sides of a telephone conversation on a wax cylinder. The device is compact and in no way interferes with the ordinary use of the telephone. Batteries are provided which actuate a microphone used to amplify the sound waves. The microphone is attached to the dictating machine, which swivels into place over the wax cylinder, and is wired to the telescribe located on the user's desk. The order of recording a telephone conversation on the instrument is as follows:

The receiver of the regular desk telephone is removed from the hook and placed in a socket of the telescribe. The acoustic connection to the dictating machine is made in this way without danger of affecting the telephone line. The user then takes up a small receiver, which is a part of the instrument, and gives his call to the telephone exchange; he starts and stops the dictating machine by means of two small buttons located on the telescribe and connected to the dictating machine by a rubber tube. The messages impressed on the wax cylinder can be taken from the dictating machine in the usual manner, and both sides of a conversation transcribed for permanent record by a typist. The telescribe will be useful to firms doing much business by telephone, especially brokers, etc.

* * *

Since the beginning of the aluminum industry in 1883, when the production amounted to eighty-three pounds, the advance has been so rapid that the production in 1913 amounted to 72,500,000 pounds.

PERSONALS

A. H. Whiteside has been made vice-president and general manager of the Goulds Mfg. Co., Seneca Falls, N. Y., succeeding W. E. Davis.

S. W. Potts, mechanical engineer of the E. W. Bliss Co., Brooklyn, N. Y., has resigned to take a similar position with R. Hoe & Co., New York City.

Victor E. Schmiedeknecht, designer for the Aurora Automatic Machinery Co., Chicago, Ill., has resigned and taken a similar position with the Pneumatic Chuck Co., Louisville, Ky.

A. H. Ingle, formerly of the Ingle Machine Co., and Rochester Boring Machine Co. of Rochester, N. Y., has taken the management of the Bridgeford Machine Tool Works, Rochester, N. Y.

J. H. Maysilles, for three years superintendent of the George D. Whitcomb Co., Rochelle, Ill., recently resigned the position, and established a foundry and machine shop at Grafton, W. Va., under the firm name of Hefner & Maysilles. Mr. Maysilles is vice-president and general manager.

A. J. Gardiner, for many years connected with the Landis Tool Co., Waynesboro, Pa., has taken a position with the Modern Tool Co., Erie, Pa. Mr. Gardiner will cover the same territory as when with the Landis Tool Co., selling a full line of self-contained single pulley drive grinding machines that the Modern Tool Co. has just brought out.

Henry D. Shute has been elected treasurer of the Westinghouse Electric & Mfg. Co., to succeed T. W. Siemon, who recently resigned to take the position of secretary-treasurer of the Union Switch & Signal Co., Swissvale, Pa. Truman P. Gaylord, district manager of the Westinghouse Electric & Mfg. Co. at Chicago, was elected acting vice-president to succeed Mr. Shute.

Edward J. Kunze, who for the past four years has been assistant professor of mechanical engineering, in charge of machine design and construction at the Michigan Agricultural College, has been appointed professor of mechanical engineering in charge of the department of mechanical engineering at the Oklahoma Agricultural and Mechanical College, Stillwater, Okla.

R. Poliakoff, assistant professor and lecturer on technology in the Imperial Technical Institute of Moscow, Russia, who came to the United States in the latter part of June to study the Taylor system of management, American methods of manufacturing machine tools, etc., sailed for Russia, September 10. Prof. Poliakoff made a special study also of automobile manufacturing methods in the Ford plant at Detroit.

Howard A. Flagg who has just become associated with the selling force of the Standard Welding Co., Cleveland, Ohio, has been connected with the seamless tube industry for the past fifteen years, having held high positions in the sales departments of the Shelby Tube Co., National Tube Co. and the Ohio Seamless Tube Co. At one time Mr. Flagg was sales manager of the steel tubing department of the Standard Welding Co. He is widely known in the automobile, bicycle and motor cycle trades.

The University of Texas has established a school of mechanical engineering, and Prof. Forrest E. Cardullo, a well-known contributor to MACHINERY, is to be the head of the new school. Prof. Cardullo is a graduate of Sibley College, Cornell University, class 1901. He became instructor at Syracuse University after having acquired four years of practical experience with the McGraw Oil Co., the Cleveland *Engineer* (now merged with *Power*), and the Holly Mfg. Co. After serving successively as instructor, associate professor and professor in charge of machine work and design and of the shop, he became professor of mechanical engineering at New Hampshire State College, where he remained six years.

James Thane sailed for South America October 1 on the steamer *Vestris*, as special representative of the American Express Co. and New York Central Lines. A. B. Howard also sailed on the same steamer as special representative of the financial department of the American Express Co. Both have had many years' experience covering representative branches of foreign trade and are competent to deal with questions arising in connection therewith. They expect to visit the chief ports or commercial centers of Brazil, Argentina, Uruguay, Chile and Peru, stopping on the return journey at Panama and Colon. Exporters and importers generally may avail themselves of the services of these representatives. Communications intended for them should be addressed to the American Express Co., South American Department, 65 Broadway, New York City.

* * *

OBITUARY

James H. Van Dorn, president of the Van Dorn Iron Works Co., and the Van Dorn & Dutton Co., Cleveland, Ohio, died August 29, aged seventy-three years. Mr. Van Dorn was born in York, Ohio, and moved to Cleveland in 1873, where he founded the two companies of which he was president.

EFFECT OF LIGHT ON THE EYES*

Three years ago the American Medical Association appointed a special committee to make a study of the effect of different lighting systems on the eye. The problem of lighting, as treated by engineers, has been for the most part an attempt to discover the most efficient forms of lighting from the point of view of economy—that is, how to get the most illumination for the least expenditure of energy. The problem of this committee has been to discover the form, distribution, intensity, and quality of light from the point of view of the health of human eyes.

The work of this committee is not yet completed, but preliminary announcements of results are of considerable interest. Among the aspects of lighting that have definite relations to the eye are: evenness of illumination; the angle at which the light falls on the object viewed; the diffuseness of the light; the evenness of surface brightness; the intensity of the illumination; and the quality of the light. The first four of these factors have been found by means of experimentation to be closely connected, although not absolutely uniform in their variations. Together they constitute what the experts call the *distribution* of the light. The ideal condition of distribution is to have the illumination as uniform as possible over the field of vision, with no extremes of surface brightness.

Daylight is the most satisfactory form of illumination, from the point of view of distribution. Daylight is well diffused by numerous reflections before it reaches the windows. Inside the room, the window or skylight has a comparatively large area of relatively low brilliancy. These two factors contribute to a nearly uniform illumination of diffused light, with absence of extreme surface brightness.

Of the systems of artificial illumination, the so-called indirect is the best. In this system, the source of light is concealed from the eyes, the light being reflected to the ceilings or walls, and from these to the working surface. In direct illumination there is always the danger of having extremely bright spots in the illuminated surface. A system called the "semi-indirect" was found to be little better for the eye than the direct system. In this the light is thrown to the ceiling or walls, as in the indirect system; but part of the light is allowed to come through translucent shades.

The relation of the different systems of lighting to the diminishing efficiency of the eyes was brought out in a series of experiments in which daylight was shown to be almost without effect upon the eyes after three or four hours of work; under direct artificial illumination the eye loses working power at a very rapid rate, and almost as rapidly with the semi-indirect illumination. The indirect illumination was found nearly as harmless as the daylight. Sharpness of vision was also found to be highest, for any given degree of illumination, under daylight, and poorest under direct artificial lighting.

* From an article in the "Scientific American," August 22, 1914.

* * *

In an article by Dr. Lederer, in the *Vossiche Zeitung*, as translated by *Pages Engineering Weekly*, attention is called to the unhappy situation of the German industry at the present moment. According to the author of this article, the removal from German works of all men capable of bearing arms has "smashed industry to atoms." The crisis, with regard to money and credit, which occurred in the first instance, was accentuated by the necessity of financing the war by a single stroke. There is in evidence the apparent paradox that in spite of the increasing absorption for military purposes of men capable of working, there is an increase of unemployment among those that remain behind. Dr. Lederer states in conclusion that the available raw materials will probably not be sufficient for any length of time.

COMING EVENTS

October 22-23—Annual convention of the National Machine Tool Builders Association. Hotel Astor, New York City, headquarters. Charles E. Hildreth, general manager, Worcester, Mass.

December 1-4.—Annual meeting of the American Society of Mechanical Engineers, New York City; Engineering Societies Bldg., 29 W. 39th St., headquarters. Calvin W. Rice, secretary.

December 9-12.—Eighth annual convention of the National Society for the Promotion of Industrial Education, Richmond, Va. C. A. Prosser, secretary, 140 W. 42nd St., New York City.

December 12-19.—Second International Exposition of Safety and Sanitation, Grand Central Palace, New York City. F. W. Payne, manager, Department of Exhibits, 29 W. 39th St., New York City. The exhibit offers the opportunity to manufacturers of safety and sanitation devices to bring their products to the attention of large numbers advantageously. Last year 110,000 attended the exposition and the attendance expected this year is about 125,000.

SOCIETIES, SCHOOLS AND COLLEGES

New Mexico State School of Mines, Socorro, N. M. Catalogue 1913-1914, with announcements for 1914-1915.

Polytechnic Institute of Brooklyn, College of Engineering, Brooklyn, N. Y. Pamphlet on evening technical courses offered by the institute for 1914-1915, covering engineering and chemistry, mathematics and languages, history and economics.

Society for Electrical Development, Inc., 29 W. 39th St., New York City. Report to members for September on the progress of the society's work. The slogan of the society is, "Do It Electrically," its object being to promote the use of electricity in all industrial activities.

Municipal School of Technology, Manchester, England. Prospectus of university courses for the session 1914-15. 190 pages, 5½ by 8½ inches. Attention is called to the fact that the mechanical engineering department is equipped to give a thorough training to students specializing in that branch of engineering, as well as the more general training required by engineers.

National Association of Corporation Schools, Irving Place and Fifteenth St., New York City. Executive committee's report on scope of activities, 1914-1915. The report comprises reports of the sub-committees on safety, hygiene and cooperation, public education, allied institutions, special schools, and includes syllabi of courses recommended to be included in all corporation schools.

Detroit Technical Institute, Detroit, Mich. Catalogue 1914-15, containing faculty list, general information and specific information on the technical courses provided, which are as follows: Mechanical engineering, electrical engineering, architecture, pharmacy and chemistry, business administration, public speaking. Practical instruction is given in shop work, motor operation, plumbing, watchmaking, etc.

Michigan College of Mines, Houghton, Mich., has instituted special short courses in mining, metallurgy, mapping, methods of measurements and calculation, drawing, concrete construction, etc., for practical men. Anyone who can read and write the English language will be admitted to specialize in these subjects. The courses will require from five to twelve weeks, depending on the subjects and their scope, which will be adjusted to suit the popular demand.

American Museum of Safety, 29 W. 39th St., New York City. Leaflet containing seven rules for shop safety as follows: 1. Organize safety committees. 2. Act promptly upon recommendation for safety. 3. Safeguard all dangerous machinery and moving parts. 4. Keep the plant clean. 5. Enforce rules and regulations for safety and health. 6. Educate employes in caution and responsibility. 7. Encourage cooperation for safety. The sub-heads give further details. Copies of these rules will be sent to any address on application.

Wentworth Institute, Boston, Mass. Catalogue for 1914-1915. This school was founded by Arioch Wentworth "for the purpose of furnishing education in the mechanical arts." It provides day courses in carpentry and building, patternmaking, machine work, foundry practice, electric wiring, plumbing, machine construction and tool design, electrical construction and operation, foundry management and operation, and architectural construction. Evening shop courses are also provided as well as evening technical courses. The machine construction courses became so popular that the two-year course in foundry management and operation was added.

Pratt Institute, Brooklyn, N. Y., has issued an information sheet for prospective students in the Pratt Institute evening course in trade teaching. This course has been developed for experienced trade workers who wish to become teachers of trades. It emphasizes the fact that men with trade experience are in demand as teachers, and states what salaries are paid. These range from $800 to $2000 a year. Instructors are demanded in the machinists' trade, carpentry, cabinet making, patternmaking, electrical work, sheet metal working, printing, drafting, plumbing, etc. The statement deals also with qualifications, getting positions, etc.

NEW BOOKS AND PAMPHLETS

Manual of Engineers and Surveyors' Instruments. (Fourth Edition.) 186 pages, 5¾ by 8¼ inches. Illustrated. Published by Queen & Co., Philadelphia, Pa.

Polarimetry. 140 pages, 6 by 9 inches. Illustrated. Published by the Department of Commerce, Washington, D. C., as Circular of the Bureau of Standards, No. 44.

Disposal of Manufacturing Wastes. By James A. Newlands. 6 pages, 6 by 9 inches. Published by James A. Newlands, State Chemist, 11 Laurel St., Hartford, Conn.

The Testing of Hydrometers. 16 pages, 6 by 9 inches. Illustrated. Published by the Department of Commerce, Washington, D. C., as Circular of the Bureau of Standards No. 16.

Testing Potential Transformers. By H. B. Brooks. 6 pages, 6 by 9 inches. Published by the Department of Commerce, Washington, D. C., as Scientific Paper of the Bureau of Standards No. 217.

Flame Standards in Photometry. By E. B. Rosa and E. C. Crittenden. 40 pages, 6 by 9 inches. Illustrated. Published by the Department of Commerce, Washington, D. C., as Scientific Paper of the Bureau of Standards No. 222.

Indicator Diagrams for Marine Engineers. By W. C. McGibbon. 196 pages, 7¼ by 9½ inches. Illustrated. Published by James Munro & Co., Ltd., Glasgow, Scotland, and D. Van Nostrand Co., New York City. Price, $3 net.

Determination of Ammonia in Illuminating Gas. By J. D. Edwards. 23 pages, 6 by 9 inches. Illustrated. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 34 of the Bureau of Standards.

Production of Temperature Uniformity in an Electric Furnace. By A. W. Gray. 23 pages, 6 by 9 inches. Illustrated. Published by the Department of Commerce, Washington, D. C., as Scientific Paper of the Bureau of Standards No. 219.

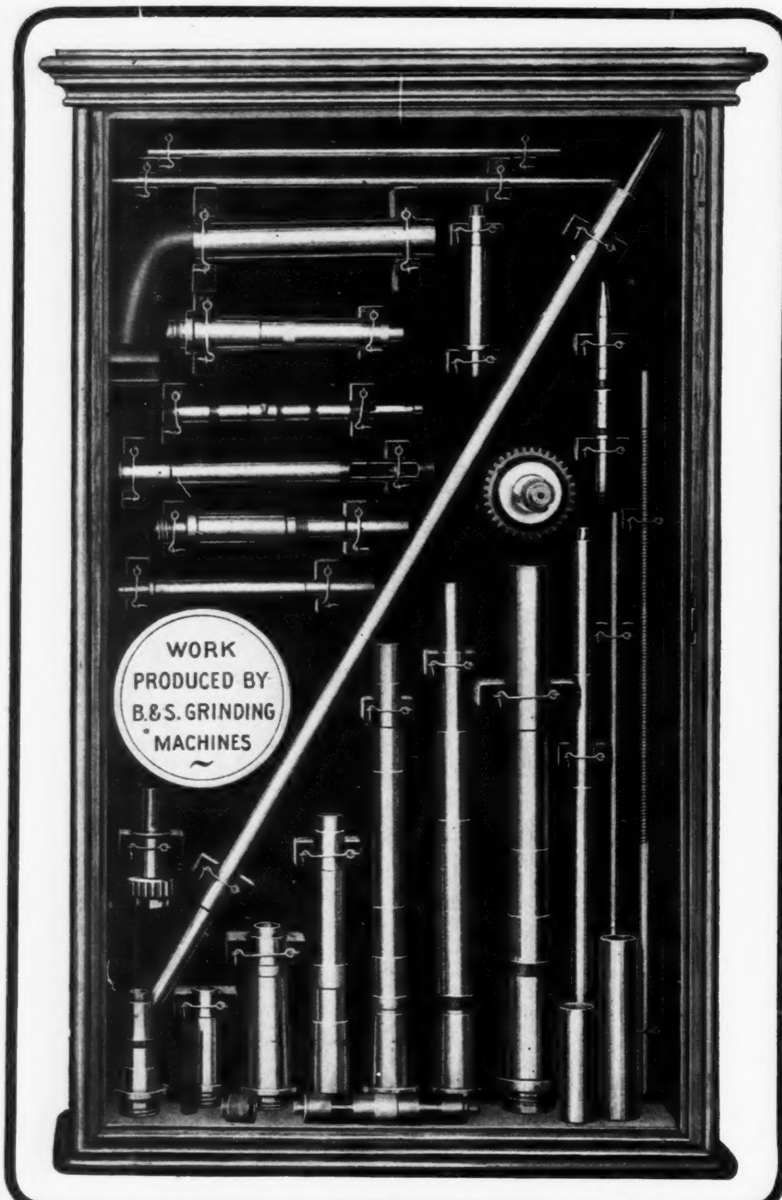
Combustion Method for the Direct Determination of Rubber. By L. G. Wesson. 11 pages, 6 by 9 inches. Illustrated. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 35 of the Bureau of Standards.

Special Studies in Electrolysis Mitigation, No. 2. By E. B. Rosa, Burton McCollum and K. H. Logan. 34 pages, 6 by 9 inches. Illustrated. Published by the Department of Commerce, Washington, D. C., as Technologic Paper of the Bureau of Standards, No. 32.

Determination of Carbon in Steel and Iron by the Barium Carbonate Titration Method. By J. R. Cain. 12 pages, 6 by 9 inches. Illustrated. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 33 of the Bureau of Standards.

Simple Problems in Marine Engineering Design. By J. W. M. Sothern and R. M. Sothern. 191 pages, 5 by 7½ inches. Published by James

How You Saving



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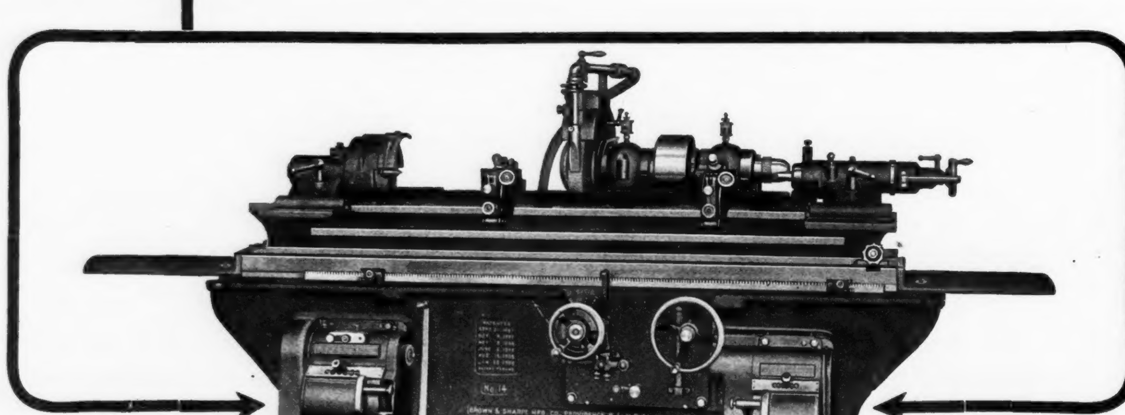

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READ PAGE 55

Munro & Co., Ltd., Glasgow, Scotland, and D. Van Nostrand Co., New York City. Price, $1 net.

The six sections of the work deal with simple mathematics; general problems; boiler design; engine design; speed, consumption and indicated horsepower; and marine turbine design.

Practical Mathematics for Young Engineers. By E. Hovenden. 144 pages, 5 by 7½ inches. Published by James Munro & Co., Ltd., Glasgow, Scotland, and D. Van Nostrand Co., New York City. Price, $1 net.

This book on arithmetic was compiled for the use of apprentices who intend to become marine engineers, and was designed to form a groundwork upon which the special knowledge necessary to obtain a Board of Trade certificate may be founded. Many of the examples are taken from the Board of Trade examination papers.

The Young Man and the Electrical Industry. By James H. Collins. 24 pages, 5 by 7 inches. Published by the Westinghouse Department of Publicity, East Pittsburg, Pa.

This booklet, reprinted from the "Scientific American," is of interest to young men. It tells what electricity might do for young men and what they might do for electricity, and is illustrated with views of the Westinghouse works, typical views of electrical apparatus in process of construction, etc. Copies can be obtained free on addressing the Westinghouse Department of Publicity.

Elementary Mathematics for Marine Engineers. By J. W. M. Sothern and R. M. Sothern. 174 pages, 5 by 7½ inches. Published by James Munro & Co., Ltd., Glasgow, Scotland, and D. Van Nostrand Co., New York City. Price, $1 net.

This work, containing algebra, logarithms, entropy, trigonometrical problems, etc., is intended as an introduction to the study of mathematics, applied to marine engineering, but with the exception of a few practical marine problems, the treatise is one of pure mathematics, as applicable to one branch of engineering as another.

The Origin of Coal. By David White and Reinhardt Thiessen. 390 pages, 6 by 9 inches. Illustrated. Published by the Department of the Interior, Bureau of Mines, Washington, D. C., as Bulletin 38.

The purpose of the studies that form the basis of this valuable report was to learn from examinations of coal how far and in what way the grouping of coal by types depends on differences in the kinds of plant material from which it was formed, and on the conditions of its accumulation. A chapter on the origin and formation of peat was contributed by Charles A. Davis. The work as a whole is a most interesting and valuable contribution to the literature on coal.

Our Mineral Reserves—How to Make America Industrially Independent. By George Otis Smith. 48 pages, 6 by 9 inches. Published by the United States Geological Survey, Department of the Interior, Washington, D. C., as Bulletin 599.

The bulletin was issued in response to the request of business men all over the country, who were writing to inquire where various mineral products could be obtained in the United States. The bulletin was prepared also to stimulate other requests for cooperation. It deals with iron, manganese, zinc, lead, tin, copper, aluminum, antimony, arsenic, platinum, radium, cement, barytes, phosphate rock, potash salts, nitrate, graphite, flint, sulphur, magnesite, fluorspar, strontium and other products.

Engine Operator's Guide. By C. E. Leslie. 76 pages, 3¾ by 6 inches. Illustrated. Published by the International Harvester Company of America, Chicago, Ill.

The author states in the preface that the object of the book is to place at the disposal of every engine owner and operator reliable information concerning internal combustion engine troubles. The fact that the book has been just issued in a fifth revised and enlarged edition indicates that it has met a common want. It treats of the installation and adjustment of gas engines, how to locate troubles, starting troubles, faulty ignition, batteries, cylinder troubles, worn valves, smoke, hot boxes, leaking gaskets, deposits in the compression chamber and water jacket, lubricating oil, care of an engine, starting and stopping engines, magneto troubles, wiring diagrams, etc. The book is of convenient form to carry in the pocket and thus to keep conveniently at hand and an ever present help in time of trouble.

Mechanics for Marine Engineers and Engineering Students. By A. N. Somerscales. 277 pages, 5 by 7½ inches. Published by James Munro & Co., Ltd., Glasgow, Scotland, and D. Van Nostrand Co., New York City. Price, $1.50 net.

The work consists of a series of lessons prepared with the view of treating applied mechanics by pure arithmetic. They were originally prepared for evening classes at the Hull Young People's Institute, England, and contain a large number of problems and answers involving plane figures and linear measurements; areas; solids; velocity; work required to lift weights; friction; pulleys; levers; inclined planes; wheels and axles; screws; pumps; belt, rope and toothed gearing; moments; parallelogram of forces; tension, shear and compression; strength of pipes and cylinders; strength of shafts, beams, girders; elasticity of metals; centrifugal force; kinetic energy; hydraulics; mechanical efficiency of engines, etc.

"Verbal" Notes and Sketches for Marine Engineers. By J. W. M. Sothern. 676 pages, 6 by 9 inches. Illustrated. Published by James Munro & Co., Ltd., Glasgow, Scotland, and D. Van Nostrand Co., New York City. Price, $5 net.

This work, which now appears in the eighth edition, treats of: Work shop practice; boilers; notes and sketches of various details; slide valves, piston valves, valve data; general notes and descriptions; marine engineering chemistry notes; marine electric lighting; propellers; refrigeration; internal combustion engines, etc. The work is of a very practical nature, being intended for the use of naval and mercantile marine engineers of all grades, students, foreman engineers, etc., especially when preparing for examinations. Many of the diagrams are on a large scale printed on inserts. The chapter on valve settings will especially interest those concerned with the complexities of marine engine valve gears.

American Machinists' Handbook. By Fred H. Colvin and Frank A. Stanley. 672 pages, 4 by 7 inches. Published by the McGraw-Hill Book Co., New York City. Price, $3.

This is the second edition of a reference book for the machine shop and drafting-room which was first brought out in 1908. There has been considerable material added to this edition, there being in all more than 150 additional pages, covering, in many instances, important machine shop data not touched upon in the earlier issue. The machine-building field is familiar with the book and its general arrangement, which has been retained in the present edition, the new material having been interspersed at appropriate places throughout the book. Among the subjects which are more completely handled in this book than in the previous edition are spiral gearing; milling and milling cutters; grinding and lapping; circular forming tools; broaching; fits, ball bearings; horsepower, belts and shafting; forge shop data; and miscellaneous tables.

Handbook of Tables and Formulas for Engineers. Compiled by Clarence A. Peirce and Walter B. Carver. 168 pages, 4 by 6¾ inches. Bound in flexible leather. Published by the McGraw-Hill Book Co., New York City. Price, $1.50 net.

The book was compiled to meet the needs of students of Sibley College of Cornell University and the needs of engineering students elsewhere. The formulas and data are divided into ten sections, as follows: Algebra; geometry and trigonometry; analytic geometry; calculus; measurement; physical and chemical properties of substances; mechanics; strength of materials; standard gages, fastenings and flanges; and mathematical tables. The text is printed on thin paper and the data have been arranged in a convenient and attractive form. No doubt the class for whom the work was compiled will find it a good working tool. It is not, however, a book to be recommended to engineers in general, as its scope is too limited.

Air Brake Catechism. By Robert H. Blackall. 411 pages, 4½ by 7 inches. 149 illustrations. Published by Norman W. Henley & Son, New York City. Price, $2.

This is the twenty-sixth edition of this well-known book on the air brake. The many editions brought out give evidence of the popularity of the book as well as of the catechism method, in accordance with which the book is arranged throughout. The new edition has been revised to date, and while it is practically the same as the previous issue, changes have been made where necessary. It treats on the equipment manufactured by the Westinghouse Air Brake Co. The operation of all parts of the apparatus is explained in detail, and practical methods for finding defects, together with proper remedies, are given. The book contains 2500 questions relating to air brake mechanism, the answers to which are given in a direct and simple manner. It is intended for engineers and firemen and other railroad men, preparing to pass an examination on the subject of air brakes.

The Railway Library, 1913. Compiled and edited by Slason Thompson. 469 pages, 5½ by 8½ inches. Published by R. R. Donnelley & Sons Co., Chicago, Ill. Price, 50 cents.

This book contains a collection of noteworthy addresses and papers delivered mostly during the year 1913. In addition to the various articles and addresses thus given permanent form, a number of statistical abstracts are given at the end of the book. These cover the railways of the world and are of considerable interest, although, in some instances, they ought to have been supplemented with explanatory notes where conditions differ from those in this country. For example, the statistician himself has made the usual mistake on page 414 of comparing ton-mile rates of American railways with those of various European railways, forgetting entirely that when counting ton-mile rates in this country we speak only of heavy freight traffic, whereas, in the European countries, the business that is generally handled by the express companies in this country is also included, which, of course, increases the ton-mile rate to a considerable extent, making a direct comparison absolutely impossible and valueless.

Marine Engineering Rules and Tables. By A. E. Seaton and H. M. Rounthwaite. 713 pages, 4 by 6½ inches. Published by Charles Griffin & Co., Ltd., London, and D. Van Nostrand Co., New York City. Price, $3.50 net.

The first edition of this special pocketbook of memoranda, tables, etc., for the use of marine engineers, naval architects, designers, superintendents and others engaged in the design, construction and care of marine machinery was published in 1893. Since then, ten editions of the work have been published and in this, the twelfth, an extensive revision has been made, due to the fact that conditions of marine engineering have been considerably modified, and to the introduction of the turbine and internal combustion engines to shaft propulsion, etc. The general contents comprise the following subjects: Efficiency of marine machinery; propulsion of ships and resistance; compound engines; piston speeds and revolutions of engines; cylinders, pistons; piston rods; connecting rods; shafting; thrust shafts and blocks; stern-tubes; main bearings of crankshafts; condensers; air pumps; cooling water pumps; feed and other pumps; slide valves for steam distribution; valve gears; reversing gears; steam turning gears; screw propellers; paddle-wheel propellers; steam turbines; internal combustion engines; superheated steam; balancing engines; boilers and their fittings; strength of materials; Lloyd's rules; tables, etc.

NEW CATALOGUES AND CIRCULARS

Merchant & Evans Co., Philadelphia, Pa. Pamphlet advertising the Evans automatic sprinkler apparatus.

Ready Tool Co., 223 Water St., Bridgeport, Conn. Insert leaf for general catalogue illustrating shaper and milling machine vise "hold-downs."

McGill Mfg. Co., Valparaiso, Ind. Catalogue of "Loxon" lamp guards and protectors; trouble finders; cord adjusters; gasoline torches, etc.

Trahern Pump Co., Rockford, Ill. Circular describing the Trahern power rotary force pump and giving table of sizes and list prices for same.

Moline Tool Co., Moline, Ill. Illuminated post card advertising "Hole Hogs"—the multiple-spindle drilling machines made by the company.

Joseph Dixon Crucible Co., Jersey City, N. J., has issued a handy little book of useful Spanish words and phrases, compiled for the use of tourists.

Lutter & Gies Co., Milwaukee, Wis. Circulars descriptive of the "Milwaukee" wet tool grinder and "Milwaukee" 16-, 20- and 24-inch back-geared crank shapers.

Howard E. Tracy, 393 Main St., Worcester, Mass. Circular of prices on photostat reproductions of drawings, diagrams, printed matter, typewritten letters, etc.

W. S. Rockwell Co., 50 Church St., New York City. Wall hanger, "Comparative Scale of Fahrenheit and Centigrade Thermometers" for use in furnace rooms, etc.

American Blower Co., Detroit, Mich. War map of Europe printed in colors, with data of the fighting strength and resources of the contending nations printed on the back.

U. S. Ball Bearing Mfg. Co., Oak Park, Ill. Leaflet describing U. S. ball bearings made for all kinds of service. The radial bearings are of both single- and double-row types.

American Blower Co., Detroit, Mich. Bulletin 27, treating of the "Sirocco" system of heating and ventilating and its application in Toledo's crystal palace for manufacturing enterprises.

Mark Mfg. Co., Evanston, Ill. Circular of the Mark cold-drawn steel pipe union. It has the advantages of uniform expansion, non-corrodibility, great strength, and freedom from blowholes and leaks.

Carter & Hakes Co., Sterling Place, Winsted, Conn. Circular of a quick-operating, wide-open lever vise for milling machines, drilling machines, etc. The vise is designed to give an operating opening of ¾ inch.

J. R. Long & Co., Akron, Ohio. Leaflet illustrating and describing a swivel base machinists' vise made entirely of drop-forgings. The vise locks automatically on the swivel base when the jaws are clamped.

Bernstein Mfg. Co., Third St. and Allegheny Ave., Philadelphia, Pa. Circular of pressed steel lockers, steel shelving, factory stools, wardrobes, sectional factory bins, library shelving and steel equipment for industrial plants.

Tahara Co. of America, Glenwood Ave. and Second St., Philadelphia, Pa. Catalogue describing the Tahara automatic process of burnishing silver, and the machines used. These machines employ steel balls in the polishing process.

Independent Pneumatic Tool Co., Chicago, Ill. Circular V, descriptive of "Thor" roller bearing piston air drills, pneumatic chipping, calking and flue beading hammers, turbine drills, staybolt drivers, air hose, couplings, etc.

National Transit Co., Oil City, Pa. Loose-leaf binder and bulletins 10 and 11 treating of pumping machinery. Directions for setting up and operating pumps are given, as well as tables of sizes and capacities of duplex piston pumps.

Charles H. Besly & Co., 120-B N. Clinton St., Chicago, Ill. Post-card advertising the Besly No. 15-30-C patternmakers' grinder which was exhibited at the Foundry & Machine Exhibition, Chicago, Ill., September 5 to 11.

Challenge Machine Co., Inc., 5116 Springfield Ave., Philadelphia, Pa. Leaflet of the wet tool and dry grinder wheel guard. This machine is adapted for rough dry grinding and tool grinding, being essentially two machines in one.

National Tube Co., Frick Bldg., Pittsburg, Pa. Bulletin of the N. T. C. iron-body brass-mounted wedge gate valve, illustrating a variety of styles and sizes. Tables of dimensions, comprising all essential data for users, are included.

S. W. Card Mfg. Co., Mansfield, Mass. New catalogue 27, covering the complete line of taps, dies and screw plates made by this company. The catalogue contains 168 pages, and several new lines of goods not previously shown are included.

J. R. Long & Co., Akron, Ohio. Leaflet illustrating and describing Long's instantaneous adjusting pipe cutter which provides means for quickly adjusting the rolls to a pipe and screwing the cutter against the pipe when cutting it off.

Gould & Eberhardt, Newark, N. J. Circular entitled, "Electric Motor Application to G. & E. High-duty Shapers," showing Gould & Eberhardt shapers equipped with adjustable-speed motor, with constant speed motor and with single-pulley belt drive.

Firth-Sterling Steel Co., McKeesport, Pa. Circular in regard to the supply of American tool steel, suggesting that users who have depended on a foreign supply will have no reason to go without a good steel in view of the adequate supply of good American steels.

Standard Chain Co., Pittsburg, Pa. General catalogue on chains, 122 pages, 7¾ by 10¾ inches, giving dimensions for coil chains, crane chains, dredge chains, cable chains, wagon chains, ring dogs, hooks for chains, cold-shuts, trace chains, hobble chains, heel chains, lap links, etc.

American Tool Works Co., Cincinnati, Ohio. Post card advertising "American" radial, plain radial, sensitive radial and full universal radial drills. The advantages claimed for these drills are extreme rigidity, and rapidity of operation. Some examples of work actually done by "American" drills are shown.

Gisholt Machine Co., Madison, Wis. Circular of the Gisholt automatic turret lathe, giving figures of production in the Dodge Bros. plant, Detroit, Mich., on automobile flywheels. The machines in this plant ran 21½ hours a day, each machine producing twenty-one wheels per hour. One man operated two machines.

Gisholt Machine Co., Madison, Wis. Circular of the Gisholt universal tool-grinder for grinding tool-post tools for turret lathes, shapers, boring mills, slotters, planers and engine lathes. The machine will grind tools up to 1⅞ inch by 3 inches or 1⅞ inch square, and will grind broad-face cutters up to 9 inches in length.

Extensive Mfg. Co., 90 West St., New York City. Circular of the "Simplex" combination bench filer and metal hacksaw. The machine has a stroke variable from 0 to 6 inches, and an adjustable table 10 inches in diameter. The circular gives a partial list of prominent concerns that are using the machine for filing dies, etc.

Ingersoll Milling Machine Co., Rockford, Ill. Catalogue 35, descriptive of the Ingersoll cutter grinder for grinding face milling cutters from 4½ to 36 inches diameter at one setting. The catalogue is particularly well illustrated, the details of the mechanism being shown on such an enlarged scale as to make the construction absolutely clear.

National Machinery Co., Tiffin, Ohio. National Forging Machine Talk No. 5 deals with maintaining alignment on the slides of forging machines. The new "suspended" heading and gripping slides employed on the National heavy-pattern forging machine enables the alignment to be effectually maintained and obviates any wobbling movement that might result in abnormal wear.

R. F. Lang, 8-10 Bridge St., New York City. Circular of brass machine parts produced by hydraulic pressure. It is claimed that every piece, being perfect and non-porous, the losses in material and labor resulting with castings are not incurred. The claim is made also that, with this process, brass articles can be produced at lower prices than are now paid for brass castings.

Diamond Machine Co., Providence, R. I. Catalogue illustrating and describing Diamond automatic and hand surface grinding machines built in four sizes to grind work 24, 36, 48 and 60 inches in length, 12 inches wide and 12 inches high. These machines are built either for belt or motor drive. The catalogue also gives sizes and capacity of magnetic chucks made by the company for use in connection with its grinding machines.

Panama Pacific International Exposition, San Francisco, Cal. Illustrated booklet on the Panama Canal and the Panama Pacific International Exposition beginning February 20, and closing December 4, 1915. Color studies of the exposition city give a vivid idea of the splendor of the buildings and grounds. A section of the booklet is devoted to the scenic attractions of California. Those contemplating visiting the exposition will find the booklet of much interest.

Heald Machine Co., Worcester, Mass. Catalogue of Heald magnetic chucks, describing their characteristics and showing uses. The construction is illustrated and described in detail. The line of Heald chucks comprises rotary and flat types for use on lathes, boring mills, cylindrical grinding machines, shapers, planers and surface grinding machines. The company also supplies demagnetizing switches, demagnetizers and generators for use, with the magnetic chucks.

Industrial Instrument Co., Foxboro, Mass. Bulletin 82, illustrating and describing Foxboro liquid level recording gages. Several interesting records are reproduced, showing the application of the liquid level gages in actual practice. Bulletin 88 shows Foxboro improved recording gages for all purposes. These recorders are made in three sizes, 8, 10 and 12 inches and for any range from full vacuum to 20,000 pounds per square inch pressure. A complete list of ranges, prices and code words are conveniently tabulated.

Quigley Furnace & Foundry Co., Springfield, Mass. Bulletin 5, descriptive of the oil and gas burning appliances manufactured by the company. Burners of varying designs, styles and sizes, for different fuels, are made, according to the class of work for which they are to be used. The bulletin shows high-pressure, medium-pressure and low-pressure oil burners, gas burners, fuel oil pumping systems, rotary oil pumps, steel fan pressure blowers, gages, strainers, valves, etc.

H. P. Townsend Mfg. Co., Hartford, Conn. Circular of automatic hopper-feed screw machines—shavers and slotters, pointers and threaders—adapted to handle all the various kinds of work that can be fed from a hopper or a stack feed. These machines are designed to be used instead of automatic screw machines working from the rod, the claim being made that a large economy is effected in saving of the stock wasted in chips. The company is prepared to build special machines to order.

Harris Patents Co., 200 Fifth Ave., New York City. Bulletin of the Harris valveless engine, Diesel principle, designed to start under load like a steam engine. The bulletin illustrates two- and four-cylinder engines of the two-stroke cycle type and describes the working principle. The advantages of the internal combustion engine for tug boats, police, pilot, fire boats, etc., are dwelt on at length. The fuel cost of power generated by the Harris engine is stated to be from 1/5 to 1/3 cent per horsepower hour.

Clipper Belt Lacer Co., 1020 Front Ave., Grand Rapids, Mich. Booklet entitled, "How Scotchie Made Good," containing a story of how "Scotchie"—an ambitious apprentice—in order to increase his piece-work, bought a Clipper belt-lacer out of his own earnings for use in his work, and of how through his introduction, the machine was adopted for the entire plant, resulting in much saving to the company and a "step up the ladder" for Scotchie. Those who do not know what the Clipper belt-lacer can do, will do well to get a copy of this story.

Billings & Spencer Co., Hartford, Conn. Catalogue of machinists' tools, comprising adjustable pocket wrenches; adjustable automobile wrenches; adjustable S-wrenches; bicycle wrenches; special wrenches; combination pliers; wire cutters; screw-drivers; cold chisels; tap and reamer wrenches; riveting hammers; machinists' hammers; drilling ratchets; socket wrenches; lathe dogs; adjustable and C-clamps; lathe tools; hand vises; drop-forged machine wrenches, in great variety; drop-forged wrenches in sets for automobilists; drop-forged blanks; crankshaft forgings; etc.

Tate, Jones & Co., Inc., Pittsburg, Pa. Catalogue of appliances for burning fuel oil. The first part of the book deals with the advantages to be derived from the use of oil fuel for furnaces, being illustrated with examples taken from actual practice. Following this, the importance of the burner is treated and types of Tate-Jones oil burners are illustrated. The last part of the book is devoted to pumping systems for heating and regulating the oil flow to the burners. Sizes and capacities for the steam-, belt- and motor-driven systems are given.

Illinois Steel Co., Chicago, Ill. Safety Bulletin No. 30, containing an illustration of the safety committee of slabbing and plate mills at the Illinois Steel Co.'s South Works plant in Chicago. This department has made a record of having no lost time accidents in the slabbing mill up to August this year, when the bulletin was published, although more than 125,000 tons of product had been rolled. The two plate mills had made reductions of approximately 65 per cent for accidents for 1914, as compared with the previous year. The bulletin contains helpful hints and suggestions for the prevention of accidents in the company's mills.

W. M. & C. F. Tucker, Hartford, Conn. Catalogue 5 on Tucker oil-hole covers and positive lock compression grease cups. Several new models of oil-hole covers are shown in this edition. The Tucker grease cups and oil-hole covers are efficiently protected from dirt and chips, convenient to operate and of "safety first" design. Among the types shown are two-piece oil-hole covers and cups, which can be turned in either direction, with the fingers; self-closing oil-hole covers, which are closed automatically by a ball and spring; and various other designs. Dimensions and price-lists for sizes carried in stock are given, and special sizes will be made to order. This catalogue cancels all previous editions.

Hindley Gear Co., 1105 Frankford Ave., Philadelphia, Pa. Catalogue of Hindley worm-gearing and Hindley spirals, listing wheels and worms of various leads and velocity ratios that the company is prepared to furnish on short notice. Illustrations of Hindley worm-gears and spirals appear throughout the book. The section on Hindley spirals is arranged similarly to that on worm-gearing. The term "spiral gears" is applied where the angle of teeth of the gears is such that either gear will drive freely in either direction. The company is ready to furnish these gears, which are used chiefly for automobile rear axle drive, of ratios from 1 to 1 up to 10 to 1. The catalogue also lists hobs for straight worm-gears.

Garvin Machine Co., Spring and Varick Sts., New York City. Circular 212 entitled "Automobile Manufacturing Kinks," showing a line of Garvin machines especially adapted for making automobile parts and accessories, among which are: vertical spindle milling machine for milling cylinder ends, crank and transmission cases; duplex milling machine for milling transmission and crank-cases and all double-end operations; two-head automatic tapping machine for tapping cases, cylinders and small parts in which several different sized holes are to be finished; special spark plug milling machine; automatic threading machine; duplex horizontal drill; four-head turning machine; monitor lathes with wrenchless chucks; coil forming machine; tire mold profiling machine. The list given will indicate the value of this little book to those engaged in automobile manufacture.

Hill Clutch Co., Cleveland, Ohio. New general catalogue 11, 224 pages, 6 by 9 inches, fully illustrating and describing the complete line of Hill power transmission machinery for belt and rope drive, including the Smith type of Hill friction clutches and Hill collar oiling bearings. The products made by the Hill Clutch Co. include: shafting, couplings, bearings, base plates, wall box frames, floor stands, hangers, clutches, pulleys, belt tighteners, tension carriages, rope sheaves, cement machinery, gears, sprockets, etc. The book is unusually complete, giving all the information on the line that the customer might desire. The section on manila rope transmission describes the American and English systems, the advantages of rope transmission in general, gives dimensions of sheaves for different rope sizes and width of grooves for pulleys. An interesting part of the book is that which gives instructions in transmission rope splicing. The making of the English transmission splice is described, step by step, and clearly illustrated by seven half-tone plates. The supplement contains descriptions and specifications of the new Cleveland type collar oiling bearing. The book is concluded with engineering notes of use in connection with transmission machinery.

TRADE NOTES

Lester & Wasley Co., Norwich, Conn., manufacturer of paper and novelty machinery, will move October 1 from its location on Falls Ave. to a better building at 282 Franklin St., Norwich.

Agnew Electric Welder Co., 47 Campau Bldg., Detroit, Mich., is now prepared to furnish a complete line of electric welding machines, comprising six spot welders and four butt welders of varying capacities.

Stow Mfg. Co., Binghamton, N. Y., was recently granted a United States patent on an improved electrical center grinder construction which provides an improved adjustable bearing for the armature and work spindle.

J. N. Lapointe Co., New London, Conn., is building a three-story 40 by 80-foot brick addition to its plant in order to provide better facilities for the manufacture of broaching machines. The addition will contain a hall for employes.

C. & C. Electric & Mfg. Co., Garwood, N. J., manufacturer of electric motors, generators and electric arc welding equipment, has removed its Detroit office from 144 Seyburn Ave. to 1111 Chamber of Commerce Building. The office is in charge of R. K. Slaymaker.

Interstate Machine Co., New London, Conn., has moved to Rochester, N. Y., where the company has a three-story building that provides greatly increased facilities for the line of small steam engines it manufactures. The company will also build a new force feed lubricator.

Atlas Press Co., 314 North Park St., Kalamazoo, Mich., is successor to the G. T. Eames Co., manufacturer of the Eames compound mandrel presses. The business has been run for about three years under the name of G. T. Eames Co., and the name was changed when J. H. Penniman purchased the interest of G. T. Eames.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has followed the custom four years of providing a summer course for a class of college professors in regular shop and engineering work. Eighteen professors from the prominent technical institutions took the course this year, beginning July 13 and ending August 15.

Logemann Bros. Co., Milwaukee, Wis., manufacturer of baling presses, cabbaging machines, hydraulic presses and pumps, has removed to its new plant at 32d and Burleigh Sts. The new plant was built especially for the construction of the company's products and occupies 2½ acres. The company will add to its extensive line of baling machines.

Watson-Stillman Co., 192 Fulton St., New York City, has closed a contract for over $100,000 worth of hydraulic jacks, piping, valves, fittings and hydro-erectors to be used in the construction of the tunnels under the East River, forming part of the new subway system of Greater New York. This equipment will be used with the ten shields employed for driving the tunnels.

Walworth Mfg. Co., Boston, Mass., has taken over the manufacture of the Parmelee wrench, which was originally designed for the handling of brass pipe. While it is essentially a friction grip wrench its action is positive and quick, the girth gripping with the slightest movement of the handle. The wrench will not mar any finished surface, and can be used on nipples without damaging the thread.

Gisholt Machine Co., Madison, Wis., is prepared to estimate on and build standard or special machinery complete or individual parts for same. The company's special tool department is ready to make

tools of all kinds, jigs, fixtures, etc. Good facilities are available, the plant being modern and fireproof throughout, and including a pattern shop, pattern storage, foundry and machine shop with up-to-date equipment.

Gun-crete Co., Chicago, Ill., organized early in 1914, has purchased the business of the Cement-Gun Construction Co., and has also taken over the construction department of the General Cement-Gun Co. As a result, the scope of business is greatly enlarged. In future, the combined business will be conducted under the name of Cement-Gun Construction Co., with offices at 914 S. Michigan Ave., Chicago. The officers of the company are Carl Webber, president; John V. Schaefer, secretary and treasurer; C. L. Dewey, construction manager.

Standard Welding Co., Cleveland, Ohio, is building the third large addition of the year to its plant. The building is of structural steel, covered with corrugated asbestos metal-reinforced roofing and siding, and is 60 by 240 by 30 feet. The new building will be devoted entirely to the storage of rims and will accommodate approximately 100,000 rims of various types. The construction of the new building is necessitated by the growing demands of bicycle, motorcycle and automobile manufacturers for the company's rim products, known as "Stanweld."

Museum of Commerce, Moscow, Russia. A permanent exhibition of samples, virtually constituting a Museum of Commerce, has been established by Ivan Amiroff & Co., Varvarskaja Place, Delovoj Dvor, Moscow. The object of the museum is to contribute to the development of industry and commerce in Russia. The articles exhibited may be of domestic as well as of foreign origin. They are divided into fifteen general classes, as follows: Chemical; machinery and tools; textile; woodwork; metallurgical; animal; food; paper; miscellaneous; commercial, industrial, technical and professional instruction; electrotechnical; agriculture; forestry; mining; small Russian rural industries. A copy of regulations for exhibitors may be obtained on application at the address given above.

Hoover Steel Ball Co., Ann Arbor, Mich., has broken ground for two new buildings in addition to the present plant. One building will be 40 by 156 feet and the other 40 by 200 feet. They will be devoted entirely to the manufacture of steel, brass and bronze balls, but will be utilized chiefly for the manufacture of very high-grade balls to take the place of balls formerly imported from Germany and other foreign countries. There is an increasing demand for this grade of ball and its manufacture necessitates the use of a special process. New ball machinery to meet these requirements will be installed in the new buildings. The company will produce a daily output of between 6,000,000 and 7,000,000 balls when the new buildings and equipment are completed. The company will use imported steel exclusively for its product, and has a sufficient supply on hand to last at least eighteen months.

Muir-Davidson Steel Co., 44 Cliff St., New York City, a copartnership consisting of Alexander Muir and Arthur C. Davidson, has been dissolved. The business and assets have been sold to the corporation of Samuel Fox & Co., New York City, recently formed under the laws of New York State. Alexander Muir is president of the new corporation, and will act as its general manager in the conduct of its business, which will be carried on at 44 Cliff St., including the general agency in the United States and Canada for Samuel Fox & Co., Ltd., steel manufacturers of Sheffield, England. The concern will carry in stock nickel and chrome-nickel automobile spring steel, crucible steel, carbon and high-speed steel for tools and dies, steel for cutlery, chisels, mining, hack-saw sheets, circular saw plates, cold-rolled strips and wire for pens, rules, clock and watch springs, band saws, etc.

New Process Gear Corporation, Syracuse, N. Y., is working over time in order to take care of the volume of business which is larger than any heretofore handled. Although the plant capacity was doubled less than two years ago, and was at that time claimed to be the largest in the world devoted exclusively to gear making, an additional building is now being erected and the capacity of the casehardening and heat-treating departments is again being doubled. Additional equipment ordered includes ten Fellows gear shapers, fifteen Gleason bevel gear generators, three Bullard vertical turret lathes, three Heald grinders, one Landis grinder, two National-Acme automatic screw machines and numerous special machines built to order. The total production of spur, spiral and bevel metal gears and "New Process" noiseless gears and pinions will be in excess of a million a year.

Hermann Boker & Co., 101 Duane St., New York City, whose business went into the hands of a receiver September 4, will be continued by the receivers the same as before. The entire staff of salesmen will remain on the road and the offices in Montreal, Cleveland, Chicago and New York City will continue with the same personnel. The Montreal office is in charge of F. E. Rejall; the Cleveland office, W. H. Kissam; the Chicago office, A. C. Blancke; and the New York office, Hans R. Boker. The receiver announces that the concern has on hand a large stock of automobile construction steel, tool steel, chrome-vanadium steel, composite steel, file steel, "Intra" steel, magnet steel, "Novo" high-speed steel, special turning and finishing steel, cold-rolled steel, hot-rolled steel, alloy metals, nickel anodes, drill rods, music wire, Swedish steel, etc., the stock being complete in all sizes. The organization identified with the business during the past twenty years has been retained by the receivers.

Max Ams Machine Co., Mount Vernon, N. Y., is erecting an additional plant at Bridgeport, Conn., to take care of its increasing business, especially the export trade through its representatives in South Africa, Australia, India, China, Japan, South America, England and the continent. The area of the plot in Bridgeport is fifteen acres, and a modern plant equipped with every facility to handle the output economically will be erected. The main shop and adjacent saw-tooth sections, practically of all-steel construction, will contain up-to-date equipment throughout. The main erecting shop will be provided with twenty-five-ton electric cranes, and railroad sidings will facilitate the handling of large machines and parts. A special administration building three stories high will be erected for the general and private offices and drafting-room. This building will be connected with the works by bridges. The power and heating plants will be in separate buildings. The company's product is largely machinery for making tin containers, especially those used for the preservation of food. It also builds an extensive line of power presses used generally in the sheet-metal working industry. It is expected that the new plant will be ready for occupancy about February, 1915.